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CITY COUNTY STATE

A COMBINATION OF

"MUNICIPAL JOURNAL & PUBLIC WORKS" and "CONTRACTING"

NEW YORK, MARCH 27, 1920

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CITY COUNTY STATE

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Vol. 48 NEW YORK, MARCH 27, 1920 No. 11

Repaving Granite Block Streets in New York

A large area of worn granite blocks replaced by new blocks on a new concrete base in the Borough of Manhattan during 1919. The old blocks were not recut and although only very slight grading was required, the cost was about 59 per cent greater than for similar work done in 1916.

During 1919, there were relaid in New York City, in the Borough of Manhattan alone, more than 179,000 square yards of standard granite block pavements. New blocks replaced the worn old blocks, not because the latter were worthless, but because it was deemed inadvisable to obstruct traffic by any attempt to recut them on the street and it would have entailed prohibitory delay and expense to haul them to a distant cutting yard and back again. In localities where it is permissible to recut the blocks at the same place where they are

PLACING GRANITE BLOCKS WITH A HOOK HAMMER AND WITH A STRAIGHT HAMMER.

DELIVERING HOT JOINT ASPHALT, MIXED WITH HOSE IN SERVICE CART.

removed and relaid, thus eliminating extra handling and transportation, a considerable economy may be effected by using the old blocks, as is done in some places in the Borough of Brooklyn.

The new blocks are of good quality, hard, uniform stones, carefully inspected by city officials at the quarry or as unloaded. Except between car tracks where they are a little larger, the dimensions must be 6 to 10 inches long, 3½ to 4½ inches wide, and 4¾ to 5¼ inches deep. They are dressed so that the head of the block has no depression greater than ¼ inch, and so that the side faces will make joints averaging not more than ⅜ inch wide at the top, a distance that may increase to ½ to ¾ inch at the bottom.

PREPARATION OF BASE.

The old granite blocks are barred out by hand, by a gang of 15 or 20 men using crowbars 5 or 6 feet long, and loading the blocks directly into automobiles or horse-drawn trucks for immediate removal by the contractor, who generally finds for them a good market at $25 to $30 per thousand delivered at the dock.

The same gang breaks up the old concrete base, about 6 inches thick, using for the purpose, ordinary steel crowbars and special levers, 12 to 14 feet long, that are made from 4-inch oak timber

tapered from a width of about 4 inches to a width of 6 inches at the lower end that is rounded to a chisel edge and bound with steel to protect it when forced under the edge of the concrete. These levers are operated with a paving block for fulcrum near the lower end, and raise the edge of the concrete base slab, which is then readily broken up by sledging into pieces of one-man size that are hauled immediately to the dumps by horse-drawn trucks. About 300 yards per day of granite pavement and concrete base can be ordinarily removed by one of these gangs.

After the removal of the old concrete base, the light excavation of 1 or 2 inches, necessary to bring the surface of the ground to the required subgrade, is done with shovels and light picking, the surplus earth being loaded into horse drawn trucks and hauled to the dumps. The grade is determined from the curb which is usually set in advance, and elevations are measured every 10 or 12 feet from traverse lines stretched from curb to curb. The surface of subgrade is made to conform to the pavement crown, and is finished with an accuracy of about half an inch.

HEATING JOINT ASPHALT IN PORTABLE TANK.

Usually, the grading is completed for an entire city block before the stone and sand are delivered on it by trucks and dumped in piles convenient for shoveling into the hopper of the mixer, whose wheels usually advance on two rows of longitudinal planks laid close to the center line of the street.

The exact level of the upper surface of the concrete is referred to elevation stakes, driven in advance by the foreman and verified by the inspector. The concrete is carefully shoveled and raked to approximate surface and finished by compacting with square tampers weighing about 20 pounds each, or by means of a wooden tamping template 3 inches thick, which reaches half way across the street and is operated by two men. This method is considered to give better results than the 20-pound tampers, but as it is also harder work and labor is very independent, the other method is sometimes accepted almost as a matter of necessity. A gang of about thirty men, operating a single concrete mixer, will average about 600 square yards of concrete base per 8-hour day.

LAYING GRANITE BLOCKS.

The granite blocks are laid by a gang of six to eight pavers and three or four rammers, who set and level them in a bed of cement mortar 1 inch thick. The mortar is made of one part cement and three parts fine aggregate, thoroughly mixed dry and then slightly moistened, by two men working with shovels on a mortar board and delivering it in wheelbarrows just in advance of the pavers. About 1 cubic yard of mortar is required for 50 cubic yards of pavement surface.

Sand is heated in the street, often on a 10 x 10 foot steel plate supported on paving blocks, with a space beneath in which is maintained a wood fire. The pavers work both with hook hammers and straight hammers. Many of them are Scotch, who generally prefer to stand facing at right angles to the line of blocks being laid and using a light hook hammer, a method which is considered to give better line and which enables the hook to be used to lift the stone from the pile and place it on the mortar bed thus reducing the labor. This method is more popular in Philadelphia than in New York, where most of the pavers stand squarely facing their work.

As soon as they are set, the blocks are well rammed to exact height and level, with a standard cylindrical rammer about 3 inches in diameter and 3 feet long with a large semi-circular handle on each side. The lower end consists of a 50 or 60-pound solid casting. After the blocks have been rammed and inspected, the rammers remove defective blocks and set new ones in their place with tongs, straighten out courses and fill in sand cushions to raise low blocks and ram them again to make the finished surface satisfactory to the inspector. The actual ramming occupies perhaps one-third of the rammer's entire working time.

The asphalt for the joints is heated in movable steel tanks with grates underneath, on which fires are maintained with scrap wood. A barrel of solid asphalt is placed on top of the tank and the heat from the fire below warms it sufficient to permit it to soften and flow into the tank, thus keeping it replenished as the hot asphalt is drawn through a valve in the bottom into a carrier. It is usually found convenient to operate two heating tanks together so that one may supply hot asphalt while the asphalt is being heated in the other, and thus avoid any interruption of the work.

The hot asphalt at a temperature of between 300 and 400 degrees is drawn into two-wheel concrete carts or similar carriers, in which are placed equal volumes of paving cement and hot dry sand. The contents of the carrier are thoroughly mixed by hand with hoes and distributed by men, who wheel the carriers to a point near the open joints and dump the filler on the surface of the paving stones, over which it is spread and flushed into the open joints by one man with a squeegee. Another man is required to wheel the hot sand, and another to attend to the fire under the asphalt tank. This method of applying the joint filler is considered to be much superior to the old way of pouring it directly from a spouted kettle, an operation

which invariably left voids in the joints. Usually the entire width of the street from curb to curb is paved and finished in one continuous operation, unless the street is divided by a car track, in which case the pavement each side of the track may be done separately, thus sometimes allowing traffic on one side of the street while the other side is closed.

Although the car companies are responsible for paving between their track rails and 2 feet each

EXCELLENT ALIGNMENT OF RESURFACED GRANITE

side of them, the city usually paves the 2 feet and charges the company for the work.

This work is all done by contract at an average total cost of $7.02 per square yard in 1919, as compared with $4.41 in 1916.

The work is in charge of C. M. Pinckney, chief engineer, and R. A. MacGregor, division engineer, Bureau of Highways, Department of Public Works.

Gunniting Deteriorated Wood Piles

In a railroad trestle extending beyond shore line the four-pile wooden bents were considerably deteriorated below the high water line and have recently been reinforced and protected by cement mortar applied by the gunnite process.

A mixing machine, cement gun, and supply of sand and cement were installed on a flat car followed by another flat car equipped with motor driven air compressor, pressure tank and fresh water reservoir. The gunnite was applied in a thickness of about 1/16 inch to 8 inches dependent on the condition of the piles, and wherever large holes had been eaten by marine borers they were covered by wire netting and the piling was brought up to normal size and in all cases was protected up to above high water level. Short piles were treated at the rate of almost one pile per minute and after 7 days it was difficult to break the gunnite even in the thinnest places with continuous pounding. The work was executed by a gang consisting of 1 man that handled the sand and operated the motor, another that handled the cement gun and served as conductor of the train, two men to feed sand and cement to the mixer, one man delivering the mixture to the gun and one man to operate the gun, besides a machine tender and a helper, and three men to handle the hose and nozzle.

Combined Water Works and Electric Plant

By A. K. Kennedy*

The Rockport, Indiana, Water Works Company Operates an Electric Plant by Steam Power and Pumps Water Partly by Steam and Partly by Electricity. The Combination of Utilities in One Plant Makes for Economy.

For twenty-five years we have been operating a combined steam and electric pumping and electric light plant and find the combination very satisfactory. We get our water supply from four 8-inch wells driven 85 feet into an old gravel bed of the Ohio river, so that we have a natural filtration of the river water. Three of these wells are operated by Cook steam heads, and one is electrically driven by a 10 h. p. motor. The last pumps direct into the distribution system, and the three steam driven pumps discharge the water into a reservoir at the pumping station. This reservoir has a capacity of 250,000 gallons and is held in reserve for fire purposes. We have two duplex pumps which draw from this reservoir and deliver into the distribution system. For fire pressure, 20 to 100 pounds, we cut off the water tower and pump direct to the mains. We have 350 h. p. boiler capacity, equipped with shaking grates and automatic dampers.

Our electrical equipment consists of three engines, an 80 h. p. Skinner, a 200 h. p. Skinner, and a 250 h. p. Hamilton Corlis. There are three three-phase generators, 60-cycle, one 100 k. v. a., one 125 k. v. a., and one 150 k. v. a. We give continuous service for lights and motors and have our plant pretty well loaded.

The principal advantages of a combined water and lighting plant are as follows:

1. One building,
2. One sidetrack for coal,
3. One set of engineers,
4. One general manager,
5. One office force,
6. One crew of workmen that do both plumbing and electrical wiring.

These six conditions eliminate a vast amount of unnecessary duplications of physical and economic functions, and all contribute to make a combined plant successful. I have engineered and planned combined plants at five places in Indiana, all of which are successful.

It is not necessary that the water supply should be at the electric station, but it may be located at any distance and operated successfully from the electric station. At one of the places named above, a 10-inch pipe brings the water from an impounding reservoir by gravity to the pumping station. At another, triplex pumps are operated five miles distant from the power plant.

In many cities and towns where the water works are owned by the city and the electric plant by a company the city can contract with the electric company to have the pumping done much cheaper than the city can do it.

* Secretary and Treasurer of Rockport Water Works Company.

Hetch-Hetchy Water Supply—III*

Description of $6,000,000, 112 billion-gallon impounding and storage reservoir with arch dam 400 ft. high at an elevation nearly 3,500 feet above the city of San Francisco, which it supplies. Exploration and borings at site. Clear-forest land, installation of sawmill, construction of headquarters offices, camps and shops. Road building and diversion tunnel.

The Hetch Hetchy Reservoir to store water for a supply of San Francisco will be formed by the clearing of about 2,500 acres of wild forest land and the construction of a cyclopean concrete impounding dam of the arched gravity type that will at first be built about 300 feet high from the lowest part in the foundations to the crest, about 600 feet long, 300 feet thick at the base and 15 feet thick at the top at roadway level, containing about 370,000 yards of concrete. Later the dam will be raised to nearly 400 feet, higher than that of any dam in the world yet built. Preliminary construction operations were commenced at the site in 1916, when about $150,000 was expended on this work. Up to date the total outlay in this locality has been $35,000 and it is expected that the reservoir will be completed in 1922 at a total cost of about $6,000,000.

GENERAL DESCRIPTION.

The spillway lip will be at elevation 3,720, which is 220 feet above the natural low water surface elevation in the river. The temporary initial spillway is to be of the siphon type, discharging over the downstream face of the dam. The time allowed the contractor for building this structure expires January 28, 1922.

The present contract includes the complete foundation below stream level for the ultimate dam. When it becomes necessary to add to the reservoir capacity developed by the initial dam, the dam will be brought up to its full ultimate size by adding a thickness of 80 feet on the downstream face and building it up 85 feet higher. This will make available 80 feet additional depth of reservoir, making the lake 300 feet deep at the dam. The crest length wil be about 900 feet, and the thickness at the crest 25 feet. The spillway will be a channel around the top of the dam, at elevation 3,800.

The ultimate dam will contain about 625,000 cubic yards of concrete.

The reservoir created by the initial dam will have a capacity of 66,000,000,000 gallons, or 202,000 acre-feet, which ultimately will become 112,000,000,000 gallons, or 343,000 acre feet.

The principal quantities involved in the initial dam contract include: Excavation below stream level, 77,000 cubic yards; excavation above stream level, 60,500 cubic yards; cyclopean masonry, 300,200 cubic yards; concrete not included in cyclopean masonry, 69,500 cubic yards.

The reservoir is located on the head waters of the Tuolumne River in the Sierra Nevada mountains about 150 miles east of San Francisco and where the bed of the river has an elevation of 3,500 feet above the sea.

Although the water-shed of the Tuolumne River, extending about 40 miles above the dam, is largely composed of mountains, chiefly of granite formation with little or no earth covering, the valley of the river immediately above the dam was in places densely wooded. At the dam site the valley narrows to a gorge about 140 feet wide at ordinary low water level, elevation 3,500 and 720 feet wide at the elevation of the crest of the proposed main dam, elevation 3,812.

PRELIMINARY OPERATIONS.

Reconnoissances, surveys, geological indications, and the preliminary engineering reports indicated that at the dam site, the maximum depth of bed rock below the river bed was about 40 feet. This assumption was disproved when wash borings, made through the gravel and clay in the river bed, were carried to a depth of more than 75 feet without reaching the bed rock in some places. It was therefort decided to provide for excavating a very deep foundation pit reaching everywhere to bed rock for the permanent structure, and to take suitable precautions against undermining in the construction of the much shallower foundations of the temporary diversion dam.

EXPLORATIONS.

The Board of Public Work advertised for bids to be received in December, 1916, for making core borings at Hetch Hetchy dam site, but no bids were submitted and the work being re-advertised, proposals were received and opened on January 5, 1917, and a contract for about 1,900 linear feet of borings in the river bed and slopes was made with the International Diamond Drill Contracting Co. for estimated price of $14,675.

The borings were completed within 120 days after the date of the contract and furnished data concerning the character of the geological formations on which the plans for the structure were completed and construction contracts were awarded.

These borings indicated a maximum depth of 75 feet below the river bed to the surface of sound rock and showed that the character of the rock was generally solid granite overlaid by disintegrated rock and broken stone and some earth and sand. The appearance of the rock indicated a stratum

* Part I.—154-mile aqueduct and auxiliaries for ultimate delivery of 400,000,000 gallons daily to San Francisco at estimated cost of $45,000,000. Preliminary work, $2,000,000, including construction of $2,000,000 railroad, 68 miles long. PUBLIC WORKS, March 6; page 165.

Part II.—Auxiliary 4,000 hp. hydro-electric power development with impounding dam, storage reservoir, improved river channel canal, flume and tunnel, aqueduct and steel penstock built in the Sierra Nevada mountains at a cost of $690,000 to facilitate construction of main reservoir and 18-mile aqueduct tunnel under high mountains. PUBLIC WORKS, March 20; page 203.

of very hard dense material suitable for foundations and these indications have been confirmed as the rock has been exposed by subsequent excavation.

CLEARING.

It was required that the entire reservoir area should be clear of trees and brush before water for domestic purposes was impounded, and the specifications provided that all standing trees, brush and shrubs should be cut down and used for sawlogs and cord wood, or burned. Oak, cottonwood, fir, pine and willow were cut and piled as cord wood at a price of $2.95 per cord. All soft wood including cedar, yellow pine, sugar pine and red fir more than 6 inches in diameter at the butt were classed as sawlogs, cut into lengths of 16 feet or more, peeled and stored on cedar skids in piles of 5, 10, 15 or 20, at a cost of $2.20 per 1,000 feet to be stored until the construction of the dam is begun, when they will be sawed and used for forms, buildings, etc.

Soft wood less than 6 inches in diameter at the butt, or otherwise unsuitable for sawlogs, was cut into cord wood in the same manner as the hard wood at a price of $2.45 per cord. In this way about 1,500 acres have been cleared. This involved an expenditure of about $30,000 for contract work in clearing the site up to 3,500-foot contour and work done by day labor at a cost of about $20,000.

MUNICIPAL SAWMILL CUTTING TIMBER FROM HETCH-HETCHY VALLEY FOR CONSTRUCTION PURPOSES.

CANYON RANCH SAWMILL.

A sawmill was located on property owned by the city in Canyon Ranch, grading was commenced in April, 1915, and timber was felled and hewed for a part of the mill building which was later completed with timber sawed in the mill. Equipment for the mill was purchased for about $13,000 and hauled 50 miles to the site from Chinese, the nearest point on the Sierra railroad.

The mill was operated continuously during the summer of 1916, making a product of 1,600,000 board feet of lumber and surfacing a considerable quantity of lumber, and has since been operated as required at an average cost of about $30,000 per year.

The daily 8-hour shift capacity of the mill is about 15,000 feet of sawed and surfaced lumber. About 4,000,000 feet of lumber from the Canyon Ranch has been sawed. The lumber and timber was used for all sorts of construction purposes, camp buildings, and for any permanent use for which it was suitable.

As the 4,000,000 feet thus derived was inadequate, the city made an arrangement with the department of the interior by which it acquired the right to cut 4,000,000 more feet of timber from selected trees standing on government land near the sawmill. These trees were so selected that they were taken from scattered positions in a wide area and did not denude any portion of the land or impair its picturesque appearance. The work was facilitated by the use of two logging road engines purchased for about $2,500 each.

CAMP AND FACILITIES.

The construction of camp buildings at the dam site was commenced in Sept., 1915, by building a 120 x 40-foot dining room, bunk houses, wood house, oil house, meat house, hospital, cement warehouse, shops, store houses, and various other buildings, all of a substantial type of wooden construction and provided with water supply, drainage and sanitary system, light and heating apparatus.

The camp was located on a beautiful plateau 400 feet above the floor of the valley in a location, which, originally a mosquito breeding swamp, was so thoroughly drained that it became very healthy, and will probably be maintained as a summer resort after the construction work is completed.

The main office building, serving as headquarters for all work in Tuolumne county, was built at Groveland, a village about 41 miles from the dam site. It is a two-story frame structure with rooms for offices, drafting, blue-printing, and living quarters with a steam heating plant. The adjacent warehouses were built for about $4,000, and a machine shop was built and equipped there for about $23,000.

HIGHWAYS.

Various local roads at and around the dam site, aggregating about 5 miles, were built.

A new road, 11 miles long, was also built from the Hetch Hetchy valley to Lake Eleanor which was necessitated by the construction of the impounding dam. It has a 10-foot road bed and 12 per cent maximum grade and climbs the steep cliffs by a series of switchbacks rising to an elevation more than 5,300 feet.

A road nearly 1 mile long, built on a 10 per cent grade from the camp to the Hetch Hetchy valley trails was built from the camp to and around the dam site, and a tramway was built from the Early Intake power house to the Hetch Hetchy railroad, about 3,800 feet distant, at a cost of $20,000. A trail was also made around the Hetch Hetchy reservoir above the flood line and many small branch roads were constructed for the convenience of contractors hauling materials for the dam and tunnel construction. These projects involved an outlay of about $50,000.

At the commencement of operations, the Hetch Hetchy valley was accessible only by trail and before the construction of the railroad access to it was provided by a new road 9 miles long built by the Utah Construction Co. at a cost of about $180,000. This road had a 22-foot bed, maximum grade of 4 per cent and minimum radius of curvature of 191 feet. Most of the excavated material was solid granite. It was provided with a hard surface and after being used for the transportation of preliminary materials and machinery to the dam site, it was utilized as a portion of the road bed for the Hetch Hetchy railroad. Early in the operations, the city telephone line was extended along this road to the Hetch Hetchy dam site.

DIVERSION DAM AND TUNNEL.

In order to unwater the bed of the river at the dam site, a concrete diversion dam 40 feet high will be built by the contractor constructing the dam.

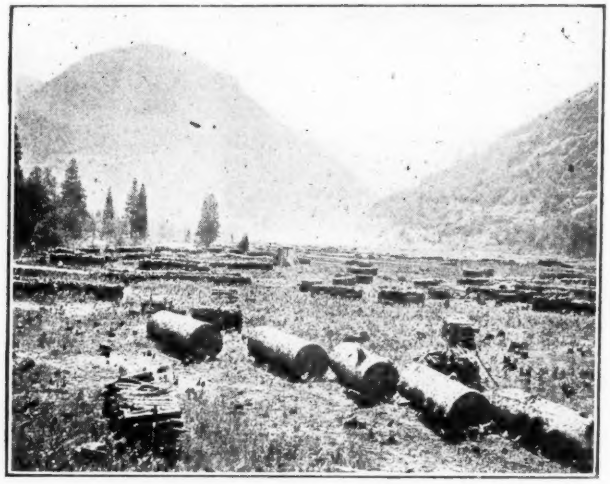
The water diverted from the river will be bypassed around the site of the permanent dam through a tunnel 23 x 25 feet, about 1,000 feet long, driven through very hard granite, most of which is suitable for concrete, and may be crushed and used in the construction of the diversion dam.

Operations on the tunnel were commenced with hand drills and carried on continuously with day and night crews until the headings met about three months after work was commenced. After the work was somewhat advanced, a $10,327 air compressing plant was installed which proved very satisfactory and also provided air for operating drills and machinery for other preliminary work, and for use during the construction of the permanent dam. The excavation of the tunnel so far completed has involved the removal of about 6,000 yards of rock at a total cost of about $6 per yard. The tunnel was excavated with a full width top heading and one bench. The design and execution of the work was carried on under the direction of M. M. O'Shaughnessy, city engineer of San Francisco.

ORGANIZATION.

The headquarters of the city's construction operations in the Sierra Nevadas is in the town of Groveland, Tuolumne County. An engineering and clerical staff is located at this point to handle estimating, mapping surveys, keeping cost accounts, making up payrolls, paying the men employed by the city, ordering supplies, other clerical work, train dispatching on the Hetch Hetchy Railroad, and many other details which can be more efficiently handled in the field close to the construction work than in the city office.

A general storehouse and central warehouse has been erected at Groveland, from which all supplies used on the work will be issued. Regular stocks of all provisions and all building materials will be handled through the storehouse. Tools, many kinds of construction equipment, and replacement parts for construction machinery, are carried in stock. The use of this storeroom assures quick delivery at the various camps.



SAW LOGS AND FIREWOOD CUT IN HETCH-HETCHY VALLEY.

In connection with the storehouse an equipment shed has been erected for storage of all equipment not in use at the various works. Here, when necessary, the equipment is overhauled, repaired, painted and placed in working shape for the next job.

Soft Coal Storage

Prevention of spontaneous combustion and deterioration of bituminous coal stored in large piles may be effected to a large degree by observing the following precautions which are made in accordance with the conclusions drawn from official tests made by the United States Bureau of Mines:

Piles not to be over 12 feet deep, and no part of the interior to be over 10 feet from the surface.

Store only screened lump coal—if possible.

Keep out dust as much as possible, and to do this avoid handling.

Have lump and fine evenly distributed. Do not let lumps roll to the bottom and form air passages.

Rehandle the screenings after two months, if possible.

Store away from any sources of even moderate heat, and well away from the main buildings of the plant; never against a frame building.

Allow six weeks seasoning after mining before putting into storage piles.

Avoid alternate wetting and drying.

Avoid admission of air to the interior of the pile through interstices around timbers, irregular brick work or a porous bottom such as coarse cinders.

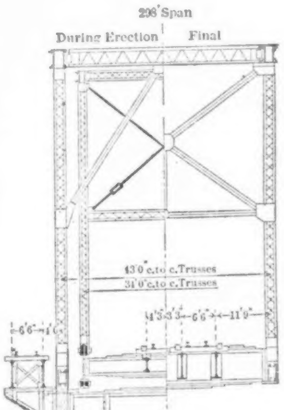
If wet coal is received, dump in small piles around the edges, where air can get to it freely to carry away moisture, and where other coal will not be packed on top of it.

Kenova Bridge Intermediate Spans

Erection of two 298-foot spans outside of old spans in service. Cantilever method using new end spans for anchorage. All steel raised 50 feet to track level by special car hoist. Two top chord travelers with two booms each, and capacity of two 51-ton loads at 70-foot radius. The floor beams, 67 feet long, were delivered on service track on cantilever span, lowered to barge, revolved 90 degrees, transverse to bridge axis and hoisted to position by traveler. Methods and plant used are suitable for consideration for replacement of long span municipal bridges.

In the re-building of the superstructure of the Norfolk & Western Railway Company's bridge over the Ohio River at Kenova, West Virginia, the two 298-foot single track end spans of the original superstructure were replaced by double track spans erected on falsework.

The three remaining spans were replaced by an entirely different method, being erected as cantilevers, clear of the old spans without involving the use of falsework, all of the operations being conducted, as for the end spans, practically without interruption of traffic on the old superstructure, the weight of which was eventually transferred to the new superstructure and finally removed, while the latter was supported from the original substructure modified as necessary.



Cross Section. Showing Clearance Between Old and New Spans.

The two intermediate 298-foot spans adjacent to the end spans of the same length are designated as spans 2 and 4 on the accompanying diagrams, and were cantilevered full length from the shore piers to the channel piers. All of the material was handled by steel mule travelers, one at each end of the bridge, advancing from the top chords of the end spans to the top chords of the intermediate span as the latter were successively erected. The steel delivered by rail in the low level storage yard at the south, or Kenova, end of the bridge was handled there by the 65-foot 30-ton booms of a tower traveler and of a stiffleg derrick that loaded it on low level cars that were transferred bodily by a vertical hoist to the high level material tracks installed or temporary cantilever brackets projecting from the ends of the floorbeams of the new spans.

The trusses of the 298-foot spans are 65½ feet deep 43 feet apart on centers with stiff bottom chords and riveted connections at panel points 29 feet 9⅝ inches apart.

ERECTION TRAVELERS.

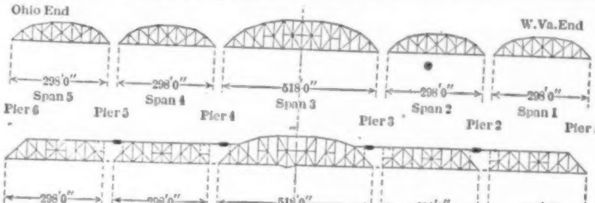
On the top chords of each of the new end span there was laid a traveler track consisting of two 8 x 16-inch timbers side by side with a rail spiked to each, on each of the trusses. On this track the small travelers commenced the erection of the two duplicate large travelers each with a 43 x 65-foot horizontal steel platform with 15-foot outriggers on each side at the forward end, and two 59-foot braced vertical steel masts with 75-foot booms of 65 tons capacity.

As the travelers were subsequently required to move on the inclined top chords of the center span of the bridge, the rear ends were afterwards supported by the adjustable struts shown in the diagram that were made with telescopic joints permitting the traveler platform to be maintained horizontal and insured the verticality of the derrick masts.

After the small traveler had erected the sills and floor of the large traveler, the former was shifted from its original track on the top chords of the old end span to one of the top chords of the new end span, and it erected on the floor of the new traveler a 12-ton steel derrick with a 65-foot boom which completed the erection of the large traveler and was then removed by the small traveler. The large traveler, weighing 423,000 pounds, was made heavier than was necessary for this work in order to be available for future work.

ERECTION TIES.

Spans 1 and 5 were each loaded at the shore end with 286,000 pounds of rails to act as cantilever counterweights and the old travelers were run as far as possible towards the shore end to assist in counter-balancing the weights of spans 2 and 4.



GENERAL ELEVATION OF OLD AND NEW SUPERSTRUCTURES ON OLD PIERS.

The adjustable horizontal erection ties in the lines of the top chords over piers 2 and 5 were about 125 feet long with gross cross-sections of 225 square inches to resist the direct tension of 4,000,000 pounds. They were plate girders made deep enough to resist the bending moment of the

large traveler crossing on them from span to span. Their lengths were adjustable by overlapping slotted pin holes, each of them containing a round pin and a D-shape plug.

The erection ties were supported over the piers by temporary vertical members indicated in the diagram by dotted lines, most of which were so designed that they could be transferred to piers 3 and 4 for the erection of the center span.

MATERIAL HOIST.

All of the 9,600 tons of material in the five main spans of the bridge was loaded on flat cars at the storage yard and delivered to the hoist at the south end of the bridge. Here long members loaded on two or more cars were hoisted and placed on push cars made from freight car trucks, on the upper tracks, leaving the low level cars at the bottom of the hoist. When the material was delivered on single cars, however, the car itself was hoisted and run out on the upper level track to deliver its load to the erection traveler.

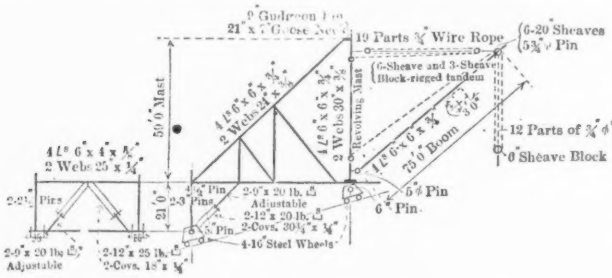
The material hoist had a wooden tower with transverse bents made with inner vertical posts and braced exterior batter posts resembling those of a gantry traveler. The posts supported two pairs of transverse plate girders spanning the upper and lower standard gage tracks parallel to each other.

On each pair of girders there was installed a four-wheel steel trolley equipped with a double drum electric hoisting engine operating a wire rope hoisting tackle and a Manila line tackle, traversing the trolley in one direction and hauling up a counterweight which pulled the trolley back.

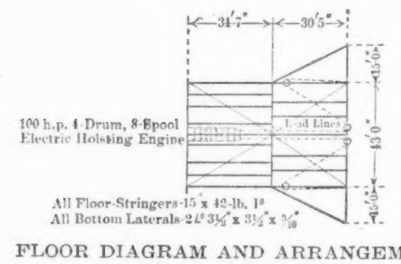
The cars had special connections to receive these trolley hoists and after they were transferred to the high level tracks they were hauled to the erection traveler by a dinky locomotive.

CANTILEVER ERECTION.

The end shoes were attached in the storage yard to the 54-ton end posts, adjustable eyebars were connected to that at the middle points, and they were each erected by one boom of the traveler. The lower ends and shoes were placed in the required



210-TON OVERHEAD ERECTION TRAVELER WITH ADJUSTABLE SUPPORT AT REAR.



FLOOR DIAGRAM AND ARRANGEMENT OF LEADS TO HOIST ON TRAVELER.

SPECIAL HOIST FOR RAISING CARS AND STRUCTURAL STEEL TO SERVICE TRACK ON BRIDGE FLOOR.

positions and the end posts were temporarily secured by connecting the upper ends of the adjustable eyebars to the tops of the temporary erection posts on the piers that were also connected to the main adjustable erection tie.

The remaining truss members in the two end panels were then assembled and the horizontal erection tie connected to the hip joint at the upper end of the end post, thus providing for the cantilever support of the truss and permitting the adjustable eyebars to be removed.

The traveler was moved out on the erection tie to a position over the center of pier 2 where it unloaded the first two floorbeams but had not sufficient reach to swing them to final position.

The floorbeams with their temporary extension brackets were 67 feet long over all, and in order to get them in position suspended transversely under the old span and clear of it, they were lowered by one traveler boom to a barge moored in the river below and then towed upstream until the other traveler boom tackle could be attached to one end of the floorbeam while the first boom was attached to the other end and together raised the floorbeam and held it until permanently secured to the bottom chords.

The stringers and material tracks were installed on the floorbeam brackets, the traveler advanced on the erection tie and top chords, the next panel of the trusses was erected and so on, until the trusses were completed with the river ends about 3 inches above their final positions.

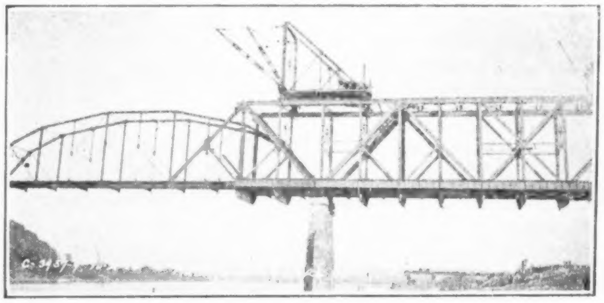
ADJUSTMENT OF SPANS.

Both old and new travelers were run over pier

FLOOR BEAM HOISTED TO FINAL POSITION AFTER BEING LOWERED TO BARGE.

2 so as to reduce their moments to a minimum. Jacking girders were attached to the adjacent ends of the spans, 1 and 2, and the jacks were operated under them until the tension in the erection ties was eliminated and each span was acting as a simple span. This required a raise of about 16 inches at the end of span 1, and 9 inches for span 2 which could not be raised farther without interfering with old span 2.

The D-shape plugs in the slotted holes of the splices in the erection ties were removed leaving the ends of the ties free to telescope over the round pin and still provide for the support of each girder in the traveler track. Traffic was stopped and the track broken for about 2 hours while the jacking was in process and the spans were lowered to final position on the piers.



OVERHEAD TRAVELER CROSSING OVER PIER ON TEMPORARY GIRDER-TIES.

After the adjustment of the new span, longitudinal I-beams were placed on their floorbeams and the weight of the old span was transferred to them, but the old trusses were allowed to remain as a counterweight while the new span served as anchor arms for the cantilever erection of the 518-foot center span, after which they were removed.

ADDITIONAL PLANT AND EQUIPMENT.

Besides the plant already mentioned there were installed on the job a 30-ton derrick car with 50-foot boom, and a 10-ton wooden derrick car. Each of the large travelers was equipped with a 100 h.p. four-drum, eight-spool hoisting engine operated by 550 volt D. C. obtained from a street car line. There were also eight steam hoisting engines on different parts of the work and two 65-h.p. two-drum, four-spool electric hoisting engines on the small travelers.

Field rivets were driven with pneumatic hammers operated by air compressed in a 12 x 12½ x 14-inch straight line compressor with a capacity of 285 cubic feet of free air per minute which was located at low level in the storage yards at the Kenova end of the bridge.

The track ties were framed by a movable machine having several adjustable circular saws for squaring the ends and cutting the dap. The saws were operated by a gasoline engine and the machine was moved from pile to pile of ties which were taken on at the front end and piled up at the rear as finished.

The bridge was designed, fabricated and erected by the American Bridge Company, C. W. Bryan, chief engineer, C. G. E. Larsson, assistant chief engineer, who devised the general construction method, W. G. Grove and Henry Taylor, assistant engineers. The diagrams illustrating this article are reprinted from a paper by W. C. Grove and Henry Taylor, published in the Transactions of the American Society of Civil Engineers, Volume 79, Page 411.

Stream Gauging Methods and Uses

An article with the above title was published in the March 6th issue of "Public Works," which was an abstract of a paper before the Connecticut Society of Engineers. It was the editor's intention to accompany this article with a foot note stating the source of the information, but the note was omitted by the printer and its absence was overlooked.

In calling our attention to this oversight, J. Frederick Jackson, director of the Bureau of Engineering of the Connecticut Department of Health, states that this "is an abstract of methods used and results obtained by this department in its investigation on the Naugatuck river in 1918 and 1919." The description itself, as printed in the annual report of the society, contains no statement or intimation of this, and our failure to state it was due to our ignorance of the fact.

Mr. Jackson also writes: "It was definitely understood that the account appearing in the 'Connecticut Society of Civil Engineers' was of a preliminary investigation, and that no conclusions other than general ones were to be drawn from it." Of this fact, also, we find no intimation in the paper as published by the society.

We are sorry that an oversight in this office caused the omission of credit to the society for this matter, and desire to correct this and to give publicity to Mr. Jackson's comments upon the paper which formed the basis of our article.

It has been announced that the Pennsylvania State Highway Department will in 1920 operate their own stone quarries and sand banks under the direction of a new department headed by D. M. Hepburn, Philadelphia.

Settling Foundations

Unstable pile footings in soft ground may be extended by deep piers or may be replacd by deep piers or by spread footings.

The Municipal elevator at Portland, Oregon, with a capacity of 45,000,000 lbs. of wheat has 63 concrete bins 14½ feet in diameter and 85 feet high that are supported on wooden piles from 45 to 60 feet long.

About 4,300 piles were driven in soft ground which they penerated an average distance of from 2 to 6 inches for each 10-foot blow of the 3,700-lb. drop hammer.

The displacement of the soft soil by driving the piles close together caused an upheaval of the surface which, after the driving had progressed for a certain time, amounted to about 1 foot. Longer piles were then driven, and after the concrete superstructure was built on them they settled so seriously that there was a maximum difference of 6 inches in level and an investigation was made to determine the cause and suitable remedy.

Test pipes and test piles were driven and test loads were applied and the results interpreted to indicate that the upper stratum of soil with a safe bearing capacity of about 2 tons per square foot was underlaid by a semi-fluid mass of smaller bearing capacity. The action of piles driven to a penetration of about 80 feet, indicated that shorter piles would not have a capacity for 25 tons each required, and that the soil to a depth of at least 41 feet below the surface was unable to bear the required uniform load of approximately 3.8 tons per square foot required for dead and live loads.

For one part of the structure where the settlement was not considered vital, it was recommended that additional piles should be driven around the footings to compress the adjacent soil and increase the area of the base and that if this proved beneficial the method could be extended to other portions of the construction.

Another plan was to underpin the existing structure by concrete piers carried down to bearing on a gravel stratum 170 feet below the surface.

The third method was for making entirely new foundations with spread footings calculated to impose an ultimate load of 2 tons per square foot on soil that is now sustaining 2 1/3 tons per square foot, without further settlement. The estimated cost of underpinning the operating house alone with deep cylinder piers varied from $140,700 to $350,000, while the cost of spread foundations for the same building moved to a new site was $150,000.

Except for the driving of additional wooden piles the reports do not suggest any consideration of the alternative or strengthening the present foundations or extending them by any other methods than the addition of exterior piles apparently intended chiefly for compressing and improving the bearing quality of the soil, nor for any method of temporary excess loading on present foundations calculated to rapidly develop total ultimate settlements and qualify them for reduced loading with an excess of bearing.

Handling Concrete Aggregate

Devices for saving labor in the handling of concrete aggregates are being tried out in a great variety of forms, and every month seems to bring information concerning some new variation of appliances or method for attaining this end. Two that have recently come to our notice have been used by contractors in Wyoming and Pennsylvania.

The Wyoming outfit is described as follows: Stationary bins were placed under a screening plant located at a gravel bed three-quarters of a mile from the job, from which bins sand and pebbles were mechanically loaded, through spouts, into three 3½-ton and one 5-ton White trucks. These were fitted up with three and six double compartments respectively, each carrying six cubic feet of sand and nine cubic feet of pebbles—the amount of each of these materials required for a 3-sack batch. The truck loaded with these three or five batches of aggregate ran direct to the mixer and dumped a batch at a time into the skip by releasing, in succession, the gates which separated the double compartments and which were hinged at the top. Cement was added to the batch in the skip by hand. It is estimated that this method of handling aggregates saved $80 per day over rehandling material between the screening plant and the mixer. This truck was used in laying concrete pavement in Thermopylis, Wyoming, by the Charles Connor Construction Company of Denver.

The other appliance, used in Pennsylvania state highway work near Lake Erie, consisted, of a horse-drawn wagon with two bodies, one above the other. Four bins of about twenty-five tons capacity each were erected at the railroad siding three-quarters of a mile from the nearest point on the road. A clam-shell unloader unloads aggregate from cars to storage piles and fills the bins from such piles. Each bin has a chute for loading wagons.

The wagon used is a standard dump wagon, into which is chuted the proper amount of stone and sand for one batch. A specially made box is then placed on top of the regular wagon body, and in this is deposited the aggregate for a second batch. The top box is attached to the bottom one by V-shaped angle irons, which in turn operate upon a shaft fastened to the rear end of the bottom box. This permits the top box to be dumped, revolving on this shaft. On reaching the mixer, the top box discharges its load directly into the skip, this being comparatively easy because of the fact that about one-third of the box overhangs the shaft about which it revolves. During or after the unloading of the top box, the contents of the bottom box are dumped upon a piece of sheet iron and reshoveled into the skip by hand for the next batch.

This limits the number of men employed on the skip end of the mixer to four. Twelve teams are used hauling material and there are eight men at the central plant, four to load wagons, one to operate the clam-shell, one fireman, and two to clean cars and assist around the plant. The Griff Construction Company, Erie, Pa., is the contractor.

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Reuse of Stone Paving Block

During the past few years a great many cities have found economy and other advantages in the practice of re-napping and re-dressing old stone blocks which had given several years' service, and relaying them on the same street, sometimes providing a new concrete base. One of the first cities to adopt this practice was New York.

The engineers of Manhattan estimate, however, that under certain conditions there are disadvantages which outweight the economy, or, to state it otherwise, the economical use of the blocks in this way produces outweighing disadvantages. Such an instance is that described in an article in this issue.

On the streets in question the traffic was so important and heavy that it seemed highly undesirable to interfere with it more than was necessary, and interference would undoubtedly result were the blocks to be re-napped and re-dressed on the street, which is the ordinary practice. Further, should the blocks be removed to a vacant lot or public yard, or other place where this re-shaping could be performed, and again returned to the street for laying, the cost of the double hauling would more than absorb the saving resulting from such re-use. Moreover, the delay thus occasioned would require keeping the street closed to traffic longer than would the use of new paving blocks which had previously been piled along the edge of the sidewalk. For this reason, the old blocks were not re-used, but were given to the contractor under the terms of his contract. As the contractor was able to sell these at $25 to $30 a thousand, and it is presumed that allowance for this was made in the bids submitted for the work, this failure to use the blocks in the new pavement did not by any means result in the total loss of their value to the city.

The above illustrates the fact that, in calculating the method which will make for maximum efficiency in paving work, there may be a number of items which do not appear at first sight. If we take into account the loss to the merchants and others by or for whom transportation of goods through the city streets is done, which would result from the temporary closing of important thoroughfares, it might easily appear not only that the re-dressing on the street of old stone blocks is, in the last analysis, far from economical, but even that there would be considerable economy in laying a pavement which would last twenty years without renewal, instead of a much less expensive one which would last but one-third of that time, and would call for the closing of the highway for repaving or repairs on three times as many occasions as would be necessary with the more expensive pavement.

Replacing Truss Bridges

The oldest steel truss bridges in this country are few of them more than 30 years old, but the rapid improvement in design, in materials, and in fabrication, together with the great increase of loading, plus the natural deterioration of structures and added injury from neglect and poor maintenance, has made virtually all of the older structures inadequate and few of these existing should not be immediately renewed. This has been more emphatically true of railroad structures which, as a general thing, have received more careful design and closer supervision, and a large number of which have already been replaced, some of them even being now about ready for a second replacement.

Highway bridges, often owned by the municipalities, and always by the public, have a large proportion of comparatively small structures which, although they should be handled in a scientific and expert manner, can be awkwardly handled without very disastrous financial results. As the spans increase, the question of replacement is a much more serious one, and as it is generally complicated by the necessity of maintaining traffic and the difficulty and expense of diverting the traffic away from the original alignment, and as the new superstructure is quite often built upon the old substructure, the perplexities and complications are likely to be great. When the experience or ingenuity of those in charge fail to find any other solution there always remains the possibility of diverting the traffic to a detour, or to a temporary new bridge established alongside, and the complete removal of the old structure and rebuilding of the new one as two separate complete operations.

This may sometimes be necessary, but is always very expensive and can often be avoided. Virtually the same problem has been met and solved by specialists in railroad and bridge engineering and the methods employed are in general applicable to highway structures. An illustration of this is given on page 237 in the description of the reconstruction of several long spans of an old bridge on which train service was maintained uninterrupted while the substructure was modified and the new spans, self-supporting during erection, were built outside the old spans, and traffic transferred to them before the old spans were replaced and this without obstructing the channel between the piers by falsework. This interesting practical demonstration indicates what may even more readily be applied to many highway structures that will soon need replacement without disturbing the traffic or obstructing the clearance under the bridge.

Improving an Inadequate Foundation

The description on page 240 of the foundation problem for a large elevator seems to indicate incompetent design, careless construction or supervision, and a narrow view of the present problem as to what should be considered as the safest and most economical correction of the original error. The original application of 25-ton loads to piles 45 to 60 feet long driven 2½ feet apart and penetrating 6 inches with the last blow of the hammer is preposterous. The recommended imposition of a unit load of 2 tons on deep plastic material that settles considerably to a final apparent stability under 2 1/3 tons is very hazardous to say the least, while the underpinning of a single one of the group of buildings at a cost of $350,000 for very deep concrete piers only partially solves the problem and is extremely expensive.

In the absence of plans and complete information, farther criticism or specific suggestions are not very valuable but it seems to the outsider that it would be very desirable to give careful consideration to some alternative methods of relief that may be found available. In New York City and elsewhere when heavy buildings are underpinned with new footings the load is frequently transferred to comparatively small sections of them in such a way as to overload them considerably beyond their final duty and immediately secure enough compression and settlement to develop permanent bearing capacity in excess of the requirements and thus insure stability under the decreased final load. Enclosing the site with a subterranean wall to prevent lateral displacement of the plastic soil or some system of artificial solidifying the soil might be helpful. The construction of a few deep piers and the accurate proportioning of the load between them and the existing foundation might also be found to be economical. Various schemes of this sort may be proposed by experienced contractors that have accomplished remarkable results in underpinning heavy structures by ingenious and daring methods that amply demonstrate their qualifications to design and execute work such as involved in this case, and which would have been unnecessary if they had been employed on the original construction.

Construction Accidents

It is authoritatively stated that in 1917 3,000,000 accidents occurred among industrial workers in the United States resulting in the disablement of 300,000 men and the death of many. While many of these accidents doubtless occurred in shops, mills, and manufactories, a large proportion were in engineering construction and, no doubt, a great majority of these were preventible.

The importance of these accidents which rival the casualties in battle, and besides human suffering involve a cost of many millions of dollars, is so well recognized that burdensome legislation has been enacted to provide compulsory insurance for employes and many "safety first" and engineering safety organizations have been formed.

In the able paper on cooperating on safety published in this issue, accidents are classified according to their number; those occurring during the handling of materials, from protruding nails, from stumbling, and from falling material being far the most numerous. Nearly one-third of the total number in the specific cases chronicled were bruised fingers, and about half as many were where the feet were punctured by protruding nails. This classification involved only ordinary kinds of heavy construction, such as steel erection, concreting, buildings, grading and track work, and did not apparently include the especially dangerous classes of work such, for instance, as tunnelling, quarrying, pneumatic caisson work, or the erection of lofty steel spans, in which conditions are sometimes so precarious that serious accidents are apparently inevitable. In these cases, however, the danger is so well recognized that extreme precautions are taken, rules are rigidly enforced and, especially of late years, the toll of casualties has been greatly decreased so that it perhaps is not larger on the whole than in some less dangerous callings where greater carelessness prevails.

Accidents are most efficiently prevented first, by the employment of more intelligent labor; second, by a continuous campaign of warning and education; third, by the conspicuous posting and rigid enforcement of safety rules and finally by the establishment, in large organizations of a safety department headed by a competent engineer or superintendent with authority, and the provision of ample facilities for the immediate relief of injured men.

The planning in advance and the co-ordination of all important portions of the work with close attention to details of methods and the selection, installation and operation of plant, goes far to reduce accidents at the same time that it lessens the cost of the work, expedites it, and indirectly more than pays for itself in the reduced cost of insurance against accidents which, under these conditions, have been reduced in two or three years to a fraction of their former proportions by some of the leading construction firms in this country.

Labor Shortage and Its Relief

Every one in this country admits the deficiency, low quality and unreliability of skilled and unskilled labor, but few perhaps realize just how great the shortage is. Recent authoritative statements estimate that there is a shortage of 33 per cent of common labor required in the United States and that the additions from immigration, now only about one-third as large as before the war, will, for a long time, be very much less than the losses from the departure of aliens. Today it is believed that there are about 4,000,000 workers short on account of decreasing immigration. Until recently the foreign-born workmen provided more than half of the unskilled labor in the basic industries.

It is very evident that immigration to this country should be encouraged, not discouraged, and that the aliens should be properly distributed according to their capacity and the demand for their services. A sort of labor clearing house should be established under joint public and private management. Its greatest danger would be from political interference and socialism that should be primarily guarded against by every possible precaution.

State Highway Construction in New York

By JAS. H. STURDEVANT*

The third of three articles. In this are described the approved methods of building a concrete highway; placing the concrete, leveling, screeding and belting; making expansion joints and curing the surface, providing water supply, building bridges, culverts and retaining walls. The standard construction equipment is enumerated and the character of engineering supervision and inspection is defined.

Concrete is deposited on subgrade between side forms, usually steel channels laid on it and held in position by pins driven through lugs projecting from their flanges. The surface is leveled with shovels and rakes and the top is dressed to the required transverse crown by means of a concave wooden screen or template usually lined with steel, that is moved forward with a reciprocating zig zag motion making a stroke of 1 or 2 feet. forward and back alternately at each end. It is handled by one man at each end and is moved on the upper flanges of the side forms that give it the required elevation.

Screeding is followed by the belt finish, applied by two men pulling a canvas belt back and forth transversely across the surface of the concrete, after which it is generally rolled lightly in a transverse direction by a hand roller about 6 feet long weighing 15 to 20 pounds per linear foot that is operated from one side of the road by a long handle or sometimes operated from both sides of the road by hand lines.

EXPANSION JOINTS.

Expansion joints located from 30 to 50 feet apart, according to specifications, are usually made with some manufactured, compressible filler extending through the full transverse width of the road and from top to bottom of the concrete. This joint or filler is generally attached to a steel plate or board put in position before the concrete is placed and withdrawn afterwards leaving a space which is immediately filled by the fresh plastic concrete. The edge of the concrete on both sides of the filler must be smoothed which is generally done by a workman with a split float. In order to avoid injuring the finished surface of the fresh concrete, a light plank bridge spanning the roadway and supported on the forms or on the right of way beyond them at the sides should be provided so that when the surface requires additional finishing between joints it can be done by the use of the bridge, moved along on the side forms.

CURING THE CONCRETE.

Each day's run of concrete should be kept saturated with water for 6 to 14 days and in hot weather should be protected from the sun for a like period to insure its proper and rapid hardening. When practicable it is generally most satisfactorily accomplished by the ponding method, which consists of building clay dams 4 or 5 inches high on both longitudinal edges of the concrete and cross dams of the same height at convenient intervals, and then filling the spaces enclosed between the dams with water from 2 to 4 inches in depth. This is easily accomplished on level grades but where there is a slope, the cross dams have to be closer and closer together as the slope increases and when they are nearer than 10 feet the method becomes expensive and troublesome. For grades above 2 or 3 per cent, the curing is usually effected by covering the surface of the concrete with sand or loam and keeping the latter saturated during the day time.

WATER SUPPLY.

Water for curing should be piped along the road and if pipes are not already installed along the road and a supply is not available from an existing municipal water system, the contractor will have to establish a supply at some stream or pond or from a well, pump it to some elevated reservoir and distribute through main and branch pipes from 1½ to ½ inch in diameter, thus providing a supply which will also suffice for a steam engine, and for concrete mixing.

If the earth cover system of curing is used, water should be supplied through long lengths of small size pipes connected to the main supply by flexible hose, and perforated with ⅛-inch holes about 12 inches apart through the full length of the pipe. Pressure should be constantly maintained on these pipes and they should be moved from place to place as the ground is saturated in one place and drys out in another.

STRUCTURES.

The principal structures ordinarily required on highways are bridges, culverts and retaining walls. In New York State bridges of more than 5 feet span are provided by the town or county and they should be completed as soon as possible after the bed is graded and before the road itself is surfaced.

Retaining walls are generally built on side hill

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slopes and may be either of rubble masonry, usually laid in cement mortar, or of concrete built in forms. In any event their foundations should be carried down to horizontal surfaces, solid rock or reliable hard stratum and they should have gravity sections with ample width to resist all possibility of displacement or overturning unless they are of concrete of the cantilever or buttress types, which are very special and cannot be treated in a general article.

In all cases they should be well provided with weep holes and bottom drainage to prevent the accumulation of water and the formation of ice behind them. They must of course be built wholly in advance of the draining and road surfacing. When built of concrete the latter may be mixed at a higher elevation and spouted to place or at low elevation and delivered by derricks. Under favorable conditions large, massive concrete may be put in position at a cost, with present prices of labor and materials, of $8 to $12 per yard.

Culverts for small streams are usually made of concrete or cast iron pipe from 10 to 30 inches in diameter, which should be installed before the embankment is made and should be laid with carefully made cement joints. The ends of the culverts should be embedded in concrete thoroughly protecting them and forming a face at the foot of the slope. In many cases it will be necessary to extend this with face walls or wings to protect the slope.

Usually large culverts up to 10 or 12 feet in width are made with concrete invert and side walls and concrete archways built with ordinary collapsible interior forms and any convenient type of exterior forms where needed. Above a width of 10 or 12 feet culverts are usually replaced by bridges with a wood or concrete floor.

EQUIPMENT.

For a 5-mile section of standard concrete highway through rough country involving perhaps from 1,000 to 10,000 yards of cut and fill per mile, an average efficient equipment for constructing a new road through country would include a 20 to 40 h.p. steam boiler or air compressor, with capacity of 500 cubic feet of free air per minute, six to twelve jackhammer drills, blasting machine, one dynamite magazine, one 1-yard steam shovel, one 20 h.p. tractor or tractor plow, one 10-ton steam roller, one concrete paving machine, two gasoline locomotives, 4 miles industrial track, 20 flat cars, 40 batch boxes for cement and aggregate, one unloading derrick or one bucket elevator, one 100-yard stone bin, one cement storage shed of 1,000-barrel capacity, two 5-ton automobile trucks, 25 wheelbarrows, 50 shovels, 25 picks, 20 tarpaulins, 6,000 feet of water pipe with valves, one movable office building together with axes, saws, hammers and other ordinary small tools and supplies. The steam shovel, tractor and some other portions of the equipment which probably answer for two 5-mile sections as well as for one. Some of the items would have to be increased or eliminated according to the presence of more rock work and timber or its absence.

SUPERVISION.

The engineer's force should maintain constantly on the work, an inspector or engineer to every 5 miles, more or less according to conditions. He should give and check, all lines and levels, provide notes for preliminary grades, inspect the subgrade and slopes and finished surface. He should insist on proper preliminary drainage, prevent the obstruction of streets and arrange well in advance for by-passes and detours to maintain traffic. He should carefully inspect the materials, testing if necessary, and should closely watch the operations and quantities used and should be responsible for the accurate proportioning of cement, sand and broken stone and water, in the concrete mixer.

He should be a man of experience, ability and reliability to whom discretionary powers are awarded, permitting him in minor matters to decide on relaxation or added stringency of the specifications for the benefit of the work, and to enable both contractor and owner to take advantage of special conditions arising. Important matters, he should of course refer to the chief engineer.

A willingness to make slight modification in the specification when it will serve the contractor's convenience or expedite the work without injury to it, will generally be appreciated by the contractor and promote a spirit of willingness to reciprocate by exceeding the specifications when necessary and securing hearty and loyal co-operation for good work.

The contractor's superintendent and foremen should be thoroughly impressed with the idea of doing the best possible work, in the most rapid and efficient way and to detect and voluntarily rectify all mistakes, thus assisting and being assisted by the engineer's representative. For every large or difficult work, the contractor should have a responsible engineer frequently on the ground to check quantities and to foresee, avert, and correct difficulties, and if there is much equipment he should provide a master mechanic and a trained force to maintain and repair the plant.

American Pavements in Japan

There are in Japan so few hard surface roads and pavements, that almost the entire highway system of the Empire awaits modern construction and amovement has been started to secure it. Prof. T. Takakuwa (219 W. 106th street, New York City) of the Kiriu Technical College is now visiting New York to study conditions and standards for the design and construction of American pavements in Japan, notably in the cities of Tokio and Osaka which have respectively about 600 miles and 300 miles of dirt streets of which not more than two or three miles, in Tokio have pavements.

A paving campaign is to be started this spring to secure within the next ten years the construction of about 200 miles of first-class pavement in Tokio. At present the traffic, although considerable, is light, consisting chiefly of horse-drawn vehicles with trucks up to 1-ton capacity and some pleasure automobiles. It is intended to provide for an increasing commercial traffic up to perhaps two or three tons. Special attention is given to bitulistic pavements, although there is in Japan abundance of stone for concrete and macadam.

It will be necessary to import all of the road making machinery, and probably some contracts will be awarded to American contractors.

Laying Sewers in Quicksand

Trench sheeted and subdrained then floored with reinforced concrete and pumped while pipe was laid and jointed.

Over a large part of the city of Jacksonville, Fla., water is found a few feet below the surface of the sand which constitutes the soil, as a result of which most of the sewers are laid in quicksand, or at least a sand which will flow wherever the water will. The sewers are laid from 5 to 11 feet deep, and at four points along the water front the house sewage (the separate system is used) is lifted so as to flow into the St. Johns river.

A small job of sewer construction which the writer saw under way in March was said to be typical of most of that done. A 10-inch sewer was being laid about 10 feet deep, ground water being encountered at about 6 feet. The trench was close-sheeted with 2-inch planks, and the joints between the planks kept calked with oakum. (In some cases tongue-and-groove planks were used.) The sheeting was driven with mauls and carried 2 to 3 feet below the sewer grade, to prevent the sand rising into the trench. In spite of these precautions quite a little sand entered the trench and caused caving of the banks.

The sand was excavated by hand. To facilitate handling the water, cross-sheeting was driven at intervals of about 50 feet and each section completed before pipe laying was begun in the next. Ordinarily work was going on in three sections at once—excavating to water in the first, bottoming out and laying sewer in the second, and back-filling and pulling sheeting in the third. A 4-inch or 5-inch subdrain was laid below the sewer to enable the trench to be kept dry during sewer laying. The water was removed by a diaphragm pump operated by a gasoline engine.

The trench was carried a foot deeper than the outside bottom of the sewer, the drain tile laid in the bottom, and 7 inches of cinders placed around it for a width of 18 inches. On these was placed 1:2:4 concrete to a depth of 5 inches, reinforced with ½-inch square rods on 18-inch centers, or with "expanded metal, wire mesh, or other approved reinforcement of equal value." On this was laid the vitrified sewer pipe, and the concrete carried up to a height of 4 inches above the bottom of the pipe, with a total width of 18 inches out-to-out, boards being set longitudinally as forms for the sides.

It is believed that this construction gives a permanence tightness to the sewer, in spite of the running sand in which it is laid. Piles are used under the sewer through swampy ground.

When a sewer is left for the night or at the completion of a section, a draining plug is fastened into the bell of the sewer with oakum. This consists of a round plug of 1-inch boards which fits loosely into the bell. In the center of the plug is a hole through which passes a 4-foot length of old suction hose from a diaphragm pump. About 2 inches of this hose extended through the plug, the end was slit in six or eight places and turned back onto the face of the plug and nailed there. This hose extended beyond the sewer and was fastened with its end just above the sand but below the water, thus draining the ground water from the trench ahead without letting in the sand.

The city has contracted with the Massey Concrete Products Corporation for reinforced concrete pipe for the larger sizes of sewers and some has been received, but none laid as yet (March 13). The so-called "tongue-and-groove" or beveled joint is being used rather than the bell and spigot.

Displacement of Earth in Sewer Trench

There are under construction in Detroit, a 32 x 17¾-foot twin box sewer and a 24-foot, 8-inch by 15 foot, 9-inch, five-center arch sewer built-in trenches 75 feet and 50 feet wide at the top and 22 feet deep that are excavated through vegetable mould and stiff yellow clay to a depth of about 13 feet and thence to subgrade through very soft plastic blue clay.

The larger trench was excavated by transverse cuts of a 3½-yard bucket operated by a 135-ton dragline machine that at first deposited the spoil close to the bank of the trench.

After about 130 feet of the trench had been excavated but not sheeted about 60 feet of the side adjacent to the spoil bank slipped into the excavation and the bottom raised 8 feet. The trench was re-excavated and the excavation continued until about 500 feet of the trench had been opened and half of the bottom covered with the concrete invert. A second slide then occurred in which the center of the spoil bank, 25 feet high that loaded the ground to about 1 ton per square foot, subsided forming a 60x250-foot crater and causing an upheaval in the bottom of the trench that raised it 3 or 4 inches under the first end where the invert was laid, and 10 or 12 feet at the opposite end. The edges of the bank were not much displaced.

The 50x22-foot trench for the arch sewer was excavated to a depth of 10 feet by a steam shovel and the remainder of the spoil was taken out by a dragline excavator that also handled the backfill. The slide which occurred in this trench was a side slip and an upheaval of the bottom.

In all cases the damage was repaired and construction resumed, care being taken to keep excavation, concreting and backfilling completed as far as possible and leave little unfinished open trench.

The obvious conclusions are, that under these conditions, the bank should not be overloaded by spoil and that where there is sufficient cover and suitable cross-section tunnel these methods are likely to be more advantageous than open cuts in this material.

Competent engineer is wanted to take charge of the construction during the next six months of an electric lighting plant for the city of Apalachicola, Fla. Address J. F. Warren, city cashier.

A 10,000,000-Feet Gas Holder

Cylindrical Tank 273 feet in diameter contains 8,500,000 pounds of steel. Bottom-plate riveted upon blocking on concrete base and lowered to sand cushion.

The new steel tank for the Peoples Gas Light and Coke Co., Chicago at 35th street and Crawford Avenue, has a capacity of 10,000,000 cubic feet, equal to 16,000,000 gallons of water and is 273 feet, 3 inches in diameter and 38 feet, 4 inches high, containing 8,500,000 pounds of steel that has been fabricated and erected by the Bartlett, Hayward Co., Baltimore.

The full size circular concrete foundation slab 12 inches thick in the center and 24 inches thick on the edges was built in a pit 8-feet deep from which 20,000 yards of earth was excavated by two steam shovels.

LOWERING BOTTOM.

The surface of the concrete base was covered with 2 inches of dry sand and temporary wooden blockings were placed on it to receive the steel base plates which were assembled together 27 inches clear of the top of the concrete. After they were field riveted their support was transferred from the wooden blocking to 42 screw jacks placed around the circumference and 192 screw jacks set on the concrete and projecting up through holes left for the purpose in the steel plates. These jacks were simultaneously operated and lowered the steel bottom to position with the rivet heads embedded in the sand that formed a distributing cushion, in 1 hour, 15 minutes. The jacks were then removed, the holes sealed, and the assembling and riveting of the circular steel wall commenced.

ERECTION OF WALL.

On the center of the bottom there was installed a temporary steel erection tower 50 feet high, guyed at the top where there was a long, hollow steel gudgeon projecting above the top of the tower to serve as the axis of two revolving radial cranes. These were two independent horizontal box girders with their outer ends resting on steel towers that traveled on a circular track laid on the tank bottom. Derrick booms were installed on the tops of the towers, one of them to handle the steel wall plates and the other to handle the large pneumatic riveter with which about 1,000,000 field rivets up to 1⅝-inches diameter were driven.

The sides of the tank were built in 8 courses of plates about 5-feet wide and from 2-inches to ½-inch thick with horizontal lapped joints and vertical butt joints having inside and outside cover plates. Compressed air to operate the hoisting engine and develop the 150-ton pressure in the riveting machine was delivered through the hollow gudgeon in the center tower. All of the riveted joints are calked with pneumatic tools. The top of the tank was made of light steel plates assembled and riveted in position on a permanent wooden framework that rests on the bottom of the tank.

Mitta Mitta Dam

The largest irrigation dam to cost $8,000,000 and impound 272,000,000,000 gal. Has curved earth embankment 2,700 feet long and 85 feet high.

The governments of New South Wales, South Australia, Victoria and the Commonwealth Government have commenced construction on a dam across the Murray River at Mitta Mitta, 6 miles from Albury which will cost about $8,000,000 and store 43,560,000,000 cubic feet or 272,250,000,000 gallons of water in a reservoir covering 30,300 acres of land and providing for a flow of 90,000 cubic feet of water per second.

This dam which is said to be the largest in the world, will have a total height of 94 feet above the bed of the river, 85 feet above the surface of the ground, and about 120 feet above the granite stratum on which the foundations are built. The dam will have a curved alignment 3,601, feet long including a concrete spillway 710 feet long, concrete outlet 161 feet long and earth section 2,700 feet long.

The spillway located in the original river bed will be of cyclopean concrete with a gravity cross-section and will be surmounted by 30 bridge piers carrying the elevated highway and serving as abutments for 31 vertically moving shutters 20 feet wide with a rise of 15 feet. They will move in sliding guides and will be operated by turbines installed in wells at both ends of the spillway.

The earth section of the dam will be 32 feet wide, 85 feet high above the surface of the ground with slopes of 3 to 1 and 2 to 1 on the upstream side and 2½ to 1 on the downstream side. The concrete core wall will be caried into bed rock and the granite hill sides. During construction the flow of the river will be by-passed through two 20x20-foot concrete tunnels built through the spillway and eventually closed by reinforced concrete bulkheads.

Philadelphia has about 600 miles of streets aggregating nearly 10,000,000 yards of asphalt pavement for which the average annual repair appropriation for the last 10 years has been $325,000 which has been found inadequate. John C. Winston, director of the Department of Public Works, has therefore applied to the city council for appropriation of $175,000 for the installation of an asphalt mixing plant with a capacity of 2,500 square yards in 8 hours. It is estimated that the plant can be equipped in about six months, could be worked continuously during the whole year and thus enable defects to be immediately repaired and promote the convenience and welfare of the public, even although the unit cost of the work done might be no less than that under the contract system.

Co-operating on Safety*

F. J. C. DRESSER,‡ *the Austin Company, Cleveland.*

* * * The present day of multiple-story buildings, when radical changes in their construction methods are being employed, finds us facing the source of the greatest number of accidents, as is attested by the high insurance rates. Usually the public comes in for consideration, as far as safety methods are concerned, and in fact no other class of structure requires more consistent planning or forethought as regards accident prevention, unless it be in tunnel or subway work as installed in our larger cities. For this work it is plain that proper and substantial equipment must be provided, that possesses a good, safe factor; the sidewalks and streets must be covered; riding loads and in hoists must be forbidden; stairways and ladders must be liberally provided; mechanical safeguards installed; rapidly moving load lines and signal cords boxed or otherwise protected; safety belts and scaffolds provided; and even a man's clothing must receive attention, for many a man has lost a hand by reason of his wearing a gauntlet glove, and others have lost arms and life because of a loose sleeve or glove which dangled into revolving drums, or shafting, or which were caught by a broken strand in a cable.

DANGEROUS WORK.

Heavy foundation work requires the same care in accident prevention study, both in bridge and in building work.

Pile driving is another hazardous piece of work, where moving timbers and lines are responsible for many avoidable accidents.

Wrecking and underpining are other sources of accidents, and more numerous undoubtedly than should be because they do not receive the attention of an engineer as regards a plan, or in other words, the average wrecking contractor does not have a staff or an engineer in his service to make calculations before doing work. As a result, defective material is often used and insufficient underpinning installed, causing accidents, of course.

Heavy rock excavation requires care in handling dynamite, and precaution against flying rock and destruction of property.

Industrial building work is the source of possibly the greatest variety of accidents, but usually not as disastrous to life and limb as the previously mentioned classes of work.

An analytical study in the direction of safety, no matter what the class of work, will certainly produce results if undertaken with the same spirit that a construction engineer plans his layout and schedule.

EMPLOYES.

In a large measure the application of safety methods depends on the employe. The more intelligent, the less liable is he to accident. In this respect, the ironworker or steel erector is possibly the most versatile in that he thinks of the possibilities of things happening in connection with the work in hand, and is not so easily caught unaware. * * *

No other mechanic requires good judgment more than the hoisting engineer, especially be he engaged on multiple-story building work or heavy bridge construction. The common laborer, however, requires more watching than the trade mechanics, and in this respect much depends on the intelligence of of the foreman who directs his movements. * * *

CHARACTER OF ACCIDENTS.

Our records, from a recent piece of construction, which involved steel erection, heavy concrete, brick work, and grading, also track work, show, from a total of 242 accidents, that: 73 employes sustained bruised fingers from handling material, 37 employes sustained punctured feet from nails, 11 employes sustained cuts on head from falling material, 7 employes sustained sprained ankles, slipping and misstepping, 7 employes sustained cuts on hands, and the balance were minor injuries. This work comprised the erection of a large engine terminal, and this record conforms in the average to the class of accidents which we must safeguard against in the course of our regular industrial building construction.

I find in comparison with figures as derived by other concerns, that the accidents in the main are similar in character, but the percentages vary, due undoubtedly to the character of the work in hand.

The greatest number of accidents, we find, come during the handling of material, and are confined to hand injuries; second in number come injuries to feet from protruding nails; third, employes falling, by reason of misstepping or stumbling over strewn material, causing sprained or broken ankles, broken arms or legs; fourth, falling material, causing cuts about the body and broken limbs. These are the four main causes as we find them, and it is natural, therefore, that preventive measures be provided in the order named.

I believe it goes without question that a job properly planned, and scheduled whereby one phase of the work closely follows the other, where material is received and handled in the same order and where orderliness prevails throughout, is rewarded by the least number of accidents.

Receiving and storing of material is a study in itself, for naturally the best position must be selected for hoists, and also for storage. One should be near the other to avoid rehandling and increased costs ,and minimum handling also reduces the possibility of accidents. * * *

The main object is to eliminate distance, for work is really distance versus resistance, as the definition goes, and the further application of all possible mechanical means to handle material from cars or wagon to position is another factor which results in a great reduction of accidents.

NAIL ACCIDENTS

Our second consideration being given to nails, we

*Excerpt of paper delivered before the Construction Section of the Eighth Annual Safety Congress of the National Safety Council at Cleveland.

‡Representing Associated General Contractors of America.

find that orderliness in handling of lumber containing protruding nails, eliminates foot punctures by the score. Plank or forms of this character should be stacked with nails down and not be allowed to be strewn all over the job. In order to reuse the plank or board, the carpenter must drive the nails back, and their removal as soon as the plank or brace is taken down is undoubtedly the best practice. As regards concrete form lumber that has been stripped, if it has no further use in the building as fabricated, it should be stacked and nails removed by the cleaning gang, if there is one, as soon as possible to make it available for other use, for certainly the reuse of lumber these days is economy, and a carpenter usually will take a new piece rather than stop to remove nails. In a multiple-story concrete building, forms are usually stripped and immediately placed in position for the next floor, and the same applies to braces, so that the immediate removal or driving back of nails is necessary and foot punctures are made less possible than on the ordinary timber or house job. Elimination of strewn lumber will reduce nail accidents and its reclamation should be taken in hand at once in order to make it fit for re-use, which in itself will cause a saving in the final lumber bill.

FALLING ACCIDENTS.

To avoid employes falling, railings should be erected on staging and scaffolds; runways of sufficient width provided; and material generally should not be strewn promiscuously about the job. Openings should be covered or railed and good stable ladders built. Climbing up or down hoist towers should be forbidden, and all moving lines boxed so as to avoid tripping. Working aisles should be kept clear of waste and surplus material.

To avoid falling material, storage of the same should be confined to the interior aisles, and scaffolds provided with a sideboard to prevent brick especially from going over the edge.

In discharging debris, closed-in chutes should be installed, wheeling runways to be of sufficient width and overloading of wheelbarrows forbidden, especially when brick are being moved. * * *

RULES AND INSTRUCTIONS.

The construction department should turn over to the safety man a complete schedule of the job in hand, showing the progress expected, this being the first step. Second, a set of safety rules should be issued applying to the work or particular job in hand, which are set up after the due analysis of the conditions which are to be met. The third, is of course, the enforcement and application of these safety rules.

First of all, any job employing 125 men or more, dependent, of course on character of the work and location, should have a first aid attendant and small field hospital. We find it pays decidedly by eliminating lost time.

Second, the job organization should appreciate thoroughly the meaning of this safety work and they will in the end discover that lower unit costs will result from the observance of the safety rules.

The workmen should be taught to observe safety rules provided as a precaution against the first or possibility second classifications, which are most liable to happen. * * *

Descriptive photographs are an immense help in avoiding accidents and educational work, and should be in keeping with the class of work in hand.

Periodical bulletins help greatly, as do also signs which should be of such size and meaning as can be understood by all. A sign that can be read only a few feet distant is not of much use; it should be readable at a considerable distance—the farther the better.

Another idea is to have progressive signs, or those which move forward with the work, cautioning what in particular may result from the work in hand at that time. These signs should be right on the job and not posted on the office door, which may be a mile away from the job. * * *

In addition, safety meetings should be held on the job by the foremen and a plan of action or procedure decided upon before particular pieces of work are undertaken, also work covered should be reviewed. * * *

Around the plant generally, guards should be built which will eliminate the possibility of employes coming in contact with the moving parts and lines, and the same consideration must be given to hoists and hoist lines. * * *

Safety rules further will establish under what conditions a machine is to be operated and how, and will also establish signal codes to be observed, for very often the operator cannot see the other end of the line or the top of the hoist, as the case may be. * * *

Above all else you must have experienced machine operators, and none other should be permitted to be employed.

The whole work, however, as regards both employes and equipment is to be reviewed and inspected by the safety engineer. * * *

Generally speaking, this subject is one that is becoming more important each year, and the increasing obligation to co-operate with safety is plain, considering the fact that in 1917, in our United States, 300,000 men were disabled and 3,000,000 minor accidents occurred in our industrial army. * * *

Waterproofing a Reservoir for 10½ Cents Per Square Foot

In the Lindsay-Strathmore Irrigation District, California, a 2-acre reservoir that was excavated in a gravel deposit proved to be so leaky that it was lined with about 114,000 square feet of reinforced gunite 1-inch thick requiring 2,900 sacks of cement and 600 tons of sand.

The gunite was placed with a N2 gun operated by air at 32 lb. pressure at the nozzle, delivered through a 2-inch pipe of maximum length of 200 feet. The nozzle was connected with the gun by 200 feet of 2-inch rubber hose and the cement was deposited on poultry netting at a maximum rate of 5,000 square feet per day. The work was done by nine men receiving $4.00, $5.00 and $7.00 a day wages that aggregated $41.00 per day. Between 8 and 9 per cent of the cement rebounded and was collected, screened, and used over again. The gunite was carefully sprinkled for two days until properly cured. The contract price was 10½ cents per foot.

Safety Rules for Construction Work

Information for the management, issued by the National Safety Council, 208 South La Salle street, Chicago, for superintendents and foremen.

FIRST CONVINCE YOURSELF that accident prevention is worth while. It reduces accidents 75 per cent or more, it reduces labor turnover, and increases efficiency. Others have obtained these results; resolve that you will obtain them.

GET THE MEN TO THINK AND ACT SAFETY. Instruct all new men in safety when they are hired. Appoint safety committees and safety men. Install safety signs, warning signs, and safety bulletin-boards. Invite the men to suggest safety rules and cautions.

USE SAFE METHODS IN DOING THE WORK. See that all safeguards are used, that materials are safely moved and well piled. Do not overload equipment, floors, falsework or scaffolds. Keep passageways open and the entire job clear of rubbish. Do not let bolts, nuts or small tools lie around to be knocked off or tripped over, nor boards with projecting nails to be stepped on. Permit no one to stand or work under a load or to ride a load being hoisted, and do not hoist a heavy load with a horizontal boom. Prohibit horseplay and practical jokes and see that they are eliminated. The public should be excluded from the job.

USE GOOD TOOLS AND EQUIPMENT. Inspect frequently and keep them in good condition. Guard all gears, pulleys, belts, electrical apparatus, etc. Provide goggles when needed to prevent eye injuries. Remember that the goose neck and gudgeon pin are the critical points of a derrick. Discard all poor equipment at once. The strength of guys, hoisting lines, ropes, blocks, hooks, chains and slings and their fastenings should be beyond question. Keep tools sharp and handles and striking faces in good condition.

USE GOOD TIMBER, WELL FRAMED AND SWAY BRACED for false work, scaffolds, shores and temporary supports. Prevent falls and injuries from falling objects by providing hand rails, toe boards and wire screens around elevated structures, scaffolds, openings and pits. Keep ladders and runways in good condition.

DO NOT WORK IF CONDITIONS ARE UNFAVORABLE because of high wind, poor light, storm, heat or cold, etc.

FIT THE MAN TO HIS JOB. Do not let a reckless, drunken or sick man work for you.

BE VIGILANT. Instruct your men to be watchful for the safety of themselves and fellow-workmen.

BE PREPARED FOR ACCIDENTS. Secure a first aid kit and learn why and how to use it. When starting a job find out about doctors, hospitals and ambulances and post the information near the telephone. Learn the prone pressure method of resuscitation from drowning, asphyxiation and electric shock. Treat all small cuts and scratches to prevent infection.

Steam Shovel Excavating Sewer Trench from Subgrade

The Ryan Co., Chicago, has recently excavated a long section of deep narrow sewer trench on Elstone avenue and Augusta street, where the clearance was very narrow transversely and shallow overhead, by means of a self-propelled steam shovel provided with a small dipper having a handle 18 feet long and operated at subgrade of the trench.

The steam shovel dug itself down to the bottom of the trench about 11 feet deep, 14 feet wide at the bottom and 17 feet wide at the top. As it advanced, the bucket dumped directly into 4-yard automobile trucks backed up in the street on the center line of the trench just in advance of the machine which excavated 280 yard per 8 hour day.

As fast as the excavation was made, the trench was sheeted with vertical planks, braced by three tiers of transverse struts behind the shovel, and one strut in front in the lower tier so that the maximum distance between braces was never more than 12 feet and then only when the shovel was in operation.

Where the trench passed under a railroad bridge with only 18 inches clearance over the top of the bucket, the excavation was made in longitudinal halves, each alternately extended 6 feet beyond the other on which the automobile trucks were spotted. They were necessarily placed in such a position that the bucket could only empty on the rear end of the trucks so that it was necessary for the bucket to be operated by the crowding engine to shove the dumped material forward in the truck to make place for another bucketful, and so on until the truck was loaded. After the steam shovel had passed under the railroad bridge, it was elevated to the surface by cribbing and jacking and was removed and replaced by a 70-ton shovel operated on the surface of the ground.

Cement Joints for Iron Pipes

About 4,000 linear feet of 6-inch and 6,000 feet of 8-inch cast iron pipes for the salt water fire protection system at San Pedro, Cal., were laid with cement joints of which only three proved defective when subjected to 48 hours for a test pressure of 180 pounds per square inch for 2 hours.

Special care was taken to set the pipes solidly in the bottom of the trench, wedging them on wooden blocks if necessary before jointing them. Soft yarn entirely free from grease was soaked in liquid cement and just enough was placed in each hub to prevent the cement from entering the pipe.

Riverside Portland cement, as dry as would permit it to be formed, was inserted in the joint and tamped solid with a large hand calking iron until the cement could not be compressed more and the tool made a ringing sound, when the joint was wiped with cement paste leveled to a 45° slope. The trench was back filled between joints which were covered with wet sacks for 48 hours before the pressure test was applied.

Preventing Dye Waste Pollution of Streams

Investigation by United States Public Health Service included aeration, charcoal preparations, chlorine, lime, boiling, alkali, strong reducing and oxidizing agents. These were compared with evaporation as a standard of cost, and ferrous salt, slaked lime and filtration recommended.

In many cases the most difficult problem to the engineer in connection with the treatment of sewage to prevent the pollution of a stream, is furnished by the trade wastes which reach the sewers or the stream direct. Each class of wastes presents its own problem, and frequently the problems for a given class vary with the individual plants.

Liquid wastes from the manufacture of dyes are particularly objectionable because of their properties of high color, bad taste and strong odor, even in very low concentrations. The treatment of such wastes was studied by the United States Public Health Service at the plant of the Chemical Company of America, located at Springfield, N. J., between Two Forks of the Rahway River. The results of this investigation was embodied in a report made in January, 1920.

In connection with the report, there is given a suggestion for a systematic set of steps to be followed in investigating and experimenting on the treatment of wastes. Evaporation is considered the simplest form of treatment for liquid effluents. On the basis that one pound of coal will evaporate 6½ pounds of water and that coal costs $7 a net ton, evaporation would cost 0.44c per gallon.

COMPARISON OF METHODS.

Any method which is to be preferred to evaporation must ordinarily be applicable at a cost less than this. The figures given below are the maximum quantities of the various materials that can be used in order that the process be cheaper than evaporation; the figures being based on market prices in June, 1919:

(1) Try aeration for blowing out bad odors.
(2) Try Filchar up to 8 pounds per thousand of waste for removing odor and color.
(3) Try chlorine (in both acid and alkaline solution) up to 8 pounds per thousand for improving odor and color.
(4) Try copperas and lime for precipitating color; also alum and lime, etc.
(5) Try boiling for removing bad odors.
(6) Try partial evaporation for removing bad odors.
(7) Try strong reducing agents; also strong oxidizing agents.
(8) Try strong alkali up to 5 pounds per thousand of waste.
(9) Investigate the manufacturing process with reference to making use of the waste again several times. For instance, in the case of the residue from the manufacture of toluidine by acid reduction of nitrotoluene, this waste might be fortified with strong acid and used again.
(10) Try shaking out with ether up to 5 pounds per thousand of waste.
(11) Try dilution.
(12) Try bacterial action.

If no satisfactory improvement is obtained by any one or combination of these schemes, then the special chemical and physical properties of the objectionable constituents should be studied.

For instance, an aldehyde might be oxidized to an acid having an insoluble lime salt, or a nitro compound might be reduced to form an amine removable by filtchar. An aromatic primary amine might be precipitated as an azo compound.

Other absorption compounds than filtchar, such as kelcar, norite, coke, talc, fuller's earth, should be studied if they offer cheaper possibilities.

With special reference to dyes which are salted out, there is a good field for studying the recovery of salt from the wastes by evaporation.

It should be remembered in any case that the waste must be made alkaline after treatment, if it is not already so, and should be allowed to stand in air as a test, for it will be oxidized as well as made alkaline in the river.

The removal of the dyes by electrical precipitation may be a field for study. It could not be studied at the experimental plant for lack of direct current power.

The above steps were followed in the investigation herein referred to, which dealt especially with toluidine, nitrobenzene, monoethyl aniline, and dye wastes, also with liquor in a lagoon into which these liquid wastes had been discharged previously. Treatments cheaper than evaporation were found that were successful on a 300-gallon scale for the lagoon liquor and for the several wastes except toluidine, and a method of treating the last was indicated by laboratory experiments.

TREATING TOLUIDINE.

Among the treatments tried for toluidine was boiling alkaline filtered waste liquor with boneblack, which was found to remove both odor and color; but the same result was accomplished by filtering the same liquid through a layer of boneblack ¼ inch thick. Quantitative experiments showed that about 1.1 cubic feet could be passed through 1 pound of boneblack before it became exhausted. Tests were made of several grades of a new carbon which has appeared on the market under the trade name of "filtchar," which appeared to be superior to ordinary carbon. "If it be assumed that a practically odorless liquid is wanted with a color of not more than five parts per million on the arbitrary scale selected, it is seen that this can be obtained by the use of 0.3% superfiltchar, or 0.8% filtchar with a treatment of 18 hours or so."

Coke and cinders failed to remove any odor or color on a large scale or in the laboratory. The above refers to toluidine waste only. When lagoon liquor was used, charcoal failed to remove the color, but boneblack, filtchar and kelcar were found effective.

RELATIVE COSTS OF METHODS.

As an illustration of relative costs, those for toludine waste were given as follows:

	per 1,000 gal.
Chlorination, 30 grams of chlorine to the liter	$15.00
Evaporation	5.00
Boneblack, 0.9 pound to the cubic foot	10.80
Filtchar, 8 pounds per 1,000 gallons	4.00
Superfiltchar, 3 pounds per 1,000 gallons	3.50

The advantages of the filtchar treatment over evaporation are that the former requires less equipment and is more flexible as regards the quality of the treated waste. These figures are based on the cost of filtchar of $.06 per pound and superfiltchar, $.14.

The cost of the several methods of treating lagoon liquor per thousand gallons were given as follows:

Evaporation	$5.50
Chlorination, 3 grams to the liter	1.00
Superfiltchar (pharmaceutical), 0.85 gram to the liter	1.33
Superfiltchar (oil grade), 0.95 gram to the liter	1.08
Filtchar, 1.7 gram to the liter	.83
Filtchar, 2.5* grams to the liter	1.25
Kelcar, 1.1 grams to the liter	.41
Precipitation, using 9.6 pounds of lime per 1,000 pounds of waste, and $FeSO_4$, 1.2 pounds per 1,000 pounds of waste	.74

TREATMENT RECOMMENDED.

On the basis of the investigation it was recommended that the Chemical Company mix together all the wastes and wash waters, except those from the "direct green" series of dyes, add ferrous salt in a wooden vat; slaked lime to neutralize the acid and give in addition eight pounds per pound of iron; to be followed by filtration through a sand filter bed or other suitable filtering medium and dilution of the effluent with at least five times its volume of water.

Street Lighting from Municipal Refuse

In a recent editorial, "Municipal Journal and The Sanitary Record," of London, used a news item which appeared in "Municipal Journal" as the text for an editorial. The editor said:

An illustration of enterprise, such as is common with American municipalities, is that furnished by the city of Scranton, Pennsylvania, who recently, according to our American contemporary "Municipal Journal," retained Mr. Frank Koester, consulting engineer and city planning expert, New York City, "to make an investigation and report regarding an entire new system for lighting all streets and some forty municipal buildings. Mr Koester proposed to use the garbage and refuse (60 tons per day) as the bulk of the fuel required. The present maximum daily demand of the power plant is 500 kilowatts; however the plant is provided for twice this capacity. Some 1,300 nitrogen-filled tungsten lamps are to replace the present arc lamps. In addition, a very extended boulevard-lighting system of some 400 single-lamp standards are provided for the four business sections of the city. With the exception of the underground wires in the business sections, all other wires of the eleven circuits are to be overhead. The engineer's report shows that the city will save yearly some $25,000 by owning this municipal lighting system instead of renewing the contract with the local light company. A similar report was made very recently by the same engineer for the city of Allentown, Pa., where the savings effected would be $15,000 per year. We should much like to hear more of the scheme proposed by Mr. Koester. It is not a novel one to municipal and electrical engineers in this country. For twenty years ago great hopes were entertained that English cities could be lighted by electricity generated from the house refuse consumed in refuse destructors—hopes, however, which have failed to fructify, for we know of no English city which has made a success of it."

Nor do we know of a single city in this country which has made a success of this idea, although it has been recommended for many and tried at great expense by several. The English cannot credit (or charge) us with any originality in this matter, however, since most of the proposals to adopt this plan in the United States have been based upon the reported success of the scheme in England.

With failure to make a success of the plan in either country, further propositions for adopting it should be required to demonstrate the development of more favorable methods and conditions if they are to receive serious consideration.

Pile Driving with Submerged Hammer

The foundations for two piers of the Bear River Bridge on the Yarmouth, Nova Scotia division of the Dominion Atlantic Railway, consist of wooden piles driven to a maximum penetration of 46 feet in pits excavated to a depth of 35 feet below low water and 70 feet below high water.

The piles were driven inside a flooded cofferdam by means of a vertical guide frame suspended, from cofferdam cross timbers. The guide frame was a hollow rectangular framework like a strut, made with four 3½ x 3½-inch corner flange angles latticed together on all sides and having an interior clearance of 22 x 22 in. over the countersunk river heads. Horizontal flange angles on the upper end of the frame supported it from the cross timbers and the foundation piles were dropped through the guide frame, sometimes penetrating the bottom to a depth of 10 feet by their own weight.

The 5,000-pound drop hammer with the sides bevelled at the lower end, was inserted in the top of the guide frame and allowed to fall on the pile top from a heighth of 12 to 15 feet which was as much as the piles would endure without injury. The maximum penetration was 46 feet.

*By using 2.5 grams instead of 1.7 grams, the color was reduced from 12 to 8.

Pier 18, Jersey City

Substructure of coal handling and storage plant. 6,000 long piles driven with weighted steam hammer and hydraulic jet. 5,000 yards concrete mixed and placed by floating plant. Concrete forms anchored against uplift of fluid pressure. Pre-cast girders concreted on pier and handled by special quick-acting yoke. Design, methods and erection plant suitable for municipal construction.

The construction and equipment of Pier 18, Jersey City, will provide for the Central Railroad of New Jersey a very complete and up-to-date plant for receiving, classifying and reshipping 400 cars of coal per day and for the maintenance of a large stock of different sizes and varities of coal available for immediate delivery by gravity to tugs, steam ships and barges alongside the pier.

The plant is built with inclined tracks on which the cars, after passing through a large hot air thawing building, are delivered to two dumping machines, and after being unloaded are returned by gravity to the classification yards, while the coal is loaded directly into barges or is conveyed to the end of a long pier and deposited in any of the numerous storage bins to be provided with chutes for delivering to boats moored alongside.

GENERAL DESCRIPTION.

The pier is 184 feet wide at the shore end, 66 feet wide at the river end and 1,600 feet long. The approach to the pier on the shore was built up about 25 feet above high water level by the hydraulic fill process with materials dredged from the slip alongside which at the same time was deepened to 30 feet as described March 13, page 187.

The pier itself has a creosoted wooden pile foundation supporting the heavy reinforced concrete slab deck on which concrete piers have been built to carry reinforced concrete track girders, that extend to the beginning of the storage bins, which have not yet been installed. In general, the pier construction was of three types: (a) Track area, pile bents 15 feet on centers, piles in double bents 4 foot centers capped with 10 x 12-inch creosoted Y. P., and with a 10 x 12-inch filler between the rows at low water and another 5 inches below the top of the caps, thus forming a key for the concrete slab which is 20 inches thick and very heavily reinforced; (b) Dumper foundation pile bents 3 foot centers, piles spaced 3 feet apart capped with 10 x 12-inch and floored with 5 x 10-inch planks about 12 inches above low water, from that elevation a concrete foundation holding the anchor bolts for the dumping machinery is carried up to the general level of the pier; (c) Deck area outside of dumper foundations and track area. Single rows of piles 15 feet on centers, piles spaced 4 to 5 feet in the bents, capped with 10 x 12-inch and a 12-inch reinforced concrete deck on top of the caps in which were driven ¾ x 12-inch spikes to give rigidity. The work already executed consists principally of the dredging and filling, the erection of the thawing house and dumping machinery, pile driving and the concreting of the deck and piers.

PILE DRIVING.

About 450 of the piles for the foundations of the thawing house were driven through the filled materials and the remainder, about 5,000 in all, were driven in the pier substructure through water varying from 20 to 30 feet in depth and penetrating mud, sand, gravel and indurated material almost as refactory as hardpan. The work was done with one floating machine and two land machines.

The piles, most of them 60 to 75 feet long, were of Southern yellow pine, creosoted at the railroad company's plant at Port Reading and delivered thence to the site in lots of 100 each by catamarans floated alongside the pier. The piles were hewed to blunt points without shoes, except in the case of the thawing house piles that were provided with cast points bolted on with straps.

SPOTTING PILES.

The piles in the pier were driven with a floating pile driver equipped with a heavy drop hammer. They were lined up by ranges on two sets of vertical battens nailed to horizontal planks set by the engineers, the sets being about 60 or 70 feet apart and being moved ahead as the work progressed. These battens were uniformly set to correspond with the upstream edge of the pile, namely at a standard distance of 6 inches beyond the center point, and were sighted on by the "monkey" continually stationed in the head of the pile driver's tower to spot the piles and direct the operator.

The longitudinal spacing of the piles was determined by a float stage made of heavy timbers spiked together; this stage was moored to the last transverse bent completed and provided at the outer edge with bearings against which the next bent was driven. Many of the bents were double bents and where a single bent was driven and the length of the panel increased correspondingly, the width of the stage was enlarged to match by boltnig to it a timber of the required thickness.

JETTING AND HAMMERING.

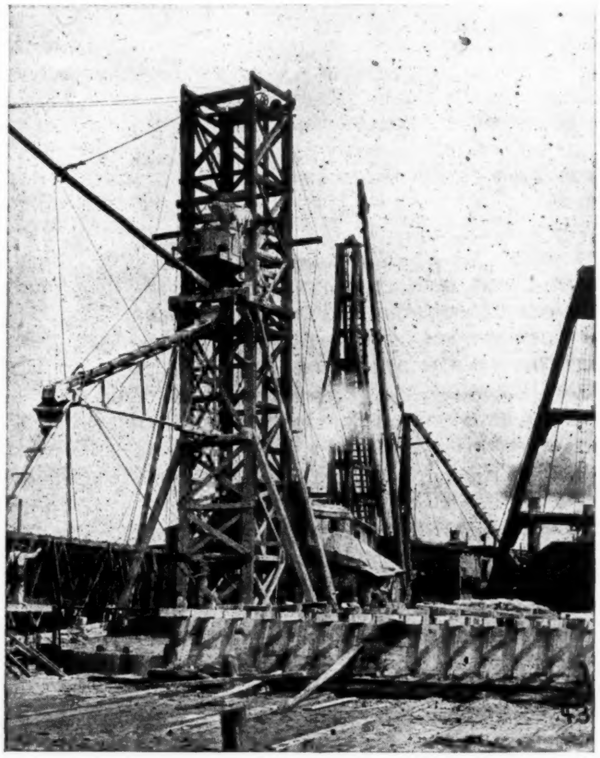
As many as 80 piles per day were driven by the floating machine but no such average was maintained, due to the complicated nature of the foundations and the difficulty in securing a sufficient quantity during the war. The thawing house foundation piles were driven with land pile drivers on rollers. Before driving, a hole was made in the fill by a ¾-inch hydraulic jet at 150 pounds pressure delivered through a 2-inch pipe. The hydraulic jet pipe was then placed alongside the pile and this was operated while the pile was driven by the steam hammer. One of the steam hammers was a 5,000-pound National hammer with a 2,000-

pound drop hammer lashed to it to increase the weight. The other was a 10,000-pound Vulcan hammer with a 5,000-pound striking hammer.

The pile driver crew, consisting of an engine man, captain and eight helpers, ordinarily drove about one pile per hour. The drivers were immediately followed by the stay-lathing gang of eight men, who lined up the piles and braced them, and in turn were followed by the framing gang of eighteen to twenty men, who sawed off the tops of the piles by using hand crosscut saws operated on pairs of horizontal guides nailed to the tops of the piles. This gang also capped the piles ready for the concreting gang. The stay laths were secured at the ends with lag screws provided with eyes in which bars could be inserted to turn them more easily than was possible with a wrench. At intersections and intermediate points the stay laths were secured with spikes.

CONCRETING.

Rectangular U-shape hangers were made of 1 x ⅛-inch flat steel with the ends twisted 90



SPOUTING CONCRETE FROM FLOATING PLANT TO MAKE MASSIVE FLOOR SLAB, PIERS AND PRE-CAST GIRDERS.

degrees and pierced with two holes through which they were secured to the tops of the 10 x 12-inch pile caps with 60-penny nails. The hangers were bent so as to be somewhat offset from the sides of the caps and to receive the 4 x 12-inch temporary stringers, set in their loops and adjusted by wedges to be ⅞ inch below the tops of the caps. On these stringers there were placed floor panels of ⅞-inch tongue-and-groove boards fastened together with cleats, providing a uniform surface flush with the pile caps over the entire pier to support the floor slab concrete from 12 to 20 inches thick. Longitudinal and transverse reinforcement bars wired together at intersections were assembled on the floor and supported at the proper heighth on steel wire chairs.

Concrete was mixed in the contractor's floating plant installed on a scow 36 feet wide and 229 feet long. On it there was a cement storage shed from which cement bags were delivered to the concrete mixer by a belt conveyor. There was also an elevated aggregate storage bin and a boom derrick with clamshell bucket that unloaded pre-mixed sand and gravel of the proper proportions from supply barges moored alongside. From the storage bin aggregate was delivered by gravity to the charging hopper installed above the 1-yard Ransome mixer. The mixed concrete was discharged directly from the mixer to the bucket in the bottom of the hoisting tower 71feet high.

At the top of the tower the concrete was discharged into a receiving hopper and thence was spouted to the forms through steel chutes, the first section of which was supported on the inclined top chord of a trussed boom revolving about 250 degrees around the hoisting tower. From the extremity of this boom a second, swiveled section of the chute, guyed to the top of the tower, provided a flexible distribution of the concrete through a radius of nearly 60 feet.

The concrete piers supporting the viaduct tracks were from 4 to 5 feet thick, 10 to 20 feet long and about 23 feet in maximum heighth above the top of the deck. The sides were slightly battered and the form for each was made with a single panel of transverse boards nailed to cross pieces, those on the two long sides slightly overlapping the end pieces that fitted between them. They were connected by horizontal bolts passing through tin tubes which permitted their removal after the concrete had set. Eventually the tubes were filled with mortar. In order to resist the uplifting tendency of the wet concrete that would otherwise raise the forms above the top of the deck, the latter were anchored down by small wire ropes attached to the upper part and secured to eyebolts temporarily screwed into permanent nuts provided ni the concrete floor slab. The forms were handled by floating derricks. The floor concrete was made in batches of about 150 to 200 cubic yards per shift, arranged so that each one could be completed the day it was commenced.

PRE-CAST GIRDERS.

With the exception of the approaches to the dumper, the tracks on the pier are carried on about 200 reinforced concrete girders 15 feet long, 5 feet in maximum depth and 18 inches thick, that weigh about 6 tons each. These girders have parallel top and bottom surfaces 3 feet apart, except at the ends where they are cast integral with knee-braces and have the maximum depth of 5 feet as already mentioned.

A portion of the deck was reserved for a casting floor large enough for 24 girders that were concreted in a single tier in a horizontal position with the wide sides down. The forms were made with single panels for each side, the panels consisting of vertical ⅞-inch tongue-and-groove boards nailed to 4 x 6-inch top and bottom wailing pieces that overlapped and were bolted together at the corners

The girders were cast in lots of 12 ,each girder

having three vertical dowels cast in the upper edge and projecting a few inches beyond it to secure the track ties. A 4 x 4-inch reinforcing timber was temporarily bolted to these dowels to strengthen the girder for handling. After 24 hours the forms were stripped, cleaned, painted with form oil, and set up again for casting another set of girders and so on.

LIFTING YOKES.

After the girders were one week old, they were handled to storage or to position by means of a special yoke attached to them at the center of gravity. This yoke consisted of a 6 x 8-inch transverse timber with a vertical 1½-inch screw rod through each end engaging a bottom plate. The lower ends of the screw rods were provided with welded loops fitting a 3 x 1-inch bottom plate about 2 feet long that slipped through them and took bearing against the horizontal lower surface of the girder, when the nuts on the upper ends of the screw rods were adjusted, thus holding the yoke firmly in position by friction. An eyebolt at the center of the transverse timber provided connection for the hoisting tackle. This yoke was found very convenient and could be very rapidly handled since it was only necessary to loosen the top nuts and slip out the bottom bearing plate to detach it and to reverse the operation for securing it to the next girder. The girders were erected by a locomotive crane.

The work was designed and executed under the direction of the engineering department of the Jersey Central R. R., A. E. Owen, chief engineer; A. M. Zabriskie, principal assistant engineer; H. E. Van Ness, construction engineer, and L. M. Hannaford, resident manager. Henry Steers, Inc., was the contractor; B. M. Wheeler, engineer, and David Bonner, Jr., superintendent.

Labor Relations in Cleveland

The committee on labor relations of the Cleveland Chamber of Commerce have just made a report containing a declaration of principles that has been printed and issued and the contemplation of the formation of a community labor policy for Cleveland to which extensive neswpaper publicity has been given since March 1, has elicited considerable comment on the principal points of representative negotiations, open or closed shops, information, and the settlement of labor disputes.

INCREASED PRODUCTION.

The report urges increasing production as a prime factor of reducing commodity prices and that this requirement should regulate profits, wages, hours and working conditions. Employees should not, therefore, intentionally restrict individual output to create an artificial scarcity of labor, but they should recognize the duty of the employer to adopt new improved machinery and methods to increase efficiency and reduce the cost of production. Employers on the other hand should not intentionally restrict production to create an artificial scarcity of the product in order to increase prices and should not reduce piece rate prices simply because they have become highly profitable to the employee through the latter's increased skill. Employers should also adjust their production program so as to afford a maximum continuity of employment consistent with efficient business methods.

WAGES.

In fixing the scale of wages, consideration should be given to the cost of living, opportunity to advance standard of living, saving, loyalty, quality and quantity of productivity, initiative and individual skill, nature and hazard of the work, importance of the work performed, punctuality and steadiness and continuity of employment.

HOURS.

Hours of work should be fixed at a point consistant with the physical well-being of the worker, providing for leisure, recreation, home life and self-development, overtime work should be discouraged, one day's rest in seven should be provided and the Saturday half holiday should be encouraged.

Every effort should be made to perfect the conditions of employment with special reference to heat, light, ventilation, safeguarding the health of workers and providing protection against industrial accidents and occupational diseases, adequate notice should be given to those who must be necessarily laid off and employees should give reasonable notice of intention to leave the service.

COLLECTIVE BARGAINING.

There should be established that form of collective bargaining which provides for negotiation between an employer and duly accredited representative of his employees, regarding hours, wages and all other matter properly affecting their relationship. The right of an individual employe to negotiate directly with his employer, should not be abrogated and employers and employes should uphold in their integrity or arbitration award or agreements entered into between them.

OPEN SHOP.

Freedom of contract of employment must never be impaired. Employment should not be arbitrarily conditioned on membership or non-membership in a trade or labor union.

Employers should inform their employes on the subject of business principles as affecting their mutual interests, especially the relation of wages and expense to cost and prices and the necessity for an equitable return on invested capital and, employes should be frank in discussing with their employer, matters affecting their conditions of employment and the interest of their industry.

Violence, intimidation, ostracism, humiliation or blacklisting cannot be tolerated in labor relations on the part either of the employer or of the employe.

The employe's right to strike and the employer's right to lockout his employes are both secondary to the public right to service. In essential industry, government services, and public utilities, prompt settlement of dispute should be effected by the efforts of both parties. The public's right to uninterrupted service during the period of settlement is a primary consideration.

According to the Massachusetts Highway Commission, the present cost of third-class bituminous road 18-feet wide is about $35,000 per mile, as compared with $15,000 to $16,000 in 1914 and 1915.

Derrick Boom 100 Feet Long

The terminal for the city of Tuscaloosa, Ala., is situated at River View, where there is 1½ miles of river frontage a short distance from the city and extensive improvements have been made including facilities for land and water shipment and storage and for future industries in the vicinity.

A group of buildings, of which one has already been built, 100 feet long, are to be served from a centrally located derrick already installed. This steel derrick, made by the American Hoist & Derrick Co., has a mast 115 feet high, a 100-foot boom and a stiffleg 145 feet long. It is designed for a capacity load of 15 tons and has been tested up to 25 tons. It is equipped with a clamshell bucket for handling coal or gravel and is mounted on a concrete pier 20 feet high and 20 feet square at the base with a footing of piles driven to a penetration of 20 feet.

With this derrick considerable timber has been loaded on cars in units of 1,000 feet board measure, which are handled rapidly at a charge of 75c each.

The work of the derrick is expedited and increased by a system of steel containers in which small quantities of freight are packed so that a number can be handled at one operation of the derrick. The container is a steel box with hinged sides that are lowered while the box is filled and then are closed and locked and the box weighing 5 tons, lifted by rings attached to the hoisting tackle so that 5-ton units of freight can be handled every 3 minutes by the derrick.

Similar steel containers are satisfactorily used in New Orleans for shipping by river and rail to remote points. In this case the containers are made larger, one of them occupying half the floor of a flat car.

Rapid Irrigation Construction

The $400,000 Williams Irrigation District system is designed to irrigate 10,000 acres of rice California lands.

The system will take water from the Sacramento river and convey it in a main canal ten miles long so constructed that its capacity can be increased.

The main canal is one-third completed and lateral construction is under way. The total yardage of 400,000 has been 25 per cent moved. Thirty miles of laterals will be built.

Pumping facilities will consist of a large plant at the river with two booster plants on the project. The river plant will have a capacity of 300 cubic feet per second supplied by four 36-inch pumps, each directly connected to a 300 h.p. induction motor. The minimum lift is 22 feet. The Latourrette-Fical Company, Sacramento, is installing the pumps. The three pumping stations will cost $220,000.

Ponding Concrete Roads

Extensive use has been made of the ponding method for curing the 18-foot concrete Salt Lake-Ogden Highway, 32 miles long in Utah. At first the surface of the fresh concrete was covered with two or three inches of wet earth which was found troublesome, expensive and not entirely efficient, and has been abandoned there except for grades of more than 6 per cent. On level surface or light grade the construction slabs 30 to 40 feet long are enclosed by small earth dams impounding from 2 to 3 inches of water. On grades from 3 to 6 per cent the dams are placed closer together. The water used for the ponding method is probably less than that required for the wet earth method.

Driving Inclined Concrete Sheet Piles

About 1,700 linear feet of inclined sea wall at Long Beach, Cal., was constructed early this year by driving 42-inch concrete sheet piles about 17½ feet long. They have an approximately channel-shape cross section with 5-inch web and 12-inch flanges. In each unit one flange is provided with a dovetail projection forming the male portion of an interlocked installation joint and the other flange has a corresponding recess forming the female portion of the joint. Most of the piles have a vertical penetration of about 10 feet, of which the last 18 inches is in a clay stratum.

The piles were driven by a wooden tower traveler equipped with leads inclined at an angle of 53 degrees, with the horizontal in which was installed a steam hammer supplementing the action of four 3-inch hydraulic jets which delivered a pressure of 60 lb. per square inch, through one-inch nozzles.

The work, including the demolition of an existing wall by blasting and battering, backfilling with a clam-shell bucket and with a 6-inch centrifugal pump, was accomplished in about five months at the expense of $112,000. The Ross Construction Co., of Sacramento, Cal., was the contractor.

Knock-Down Floor Forms

Slab and beam floors have been concreted in knock-down forms that are easily handled and facilitate stripping. Ordinary falsework timbers transverse to the beams are first erected and on them the soffit pieces of the beams are laid and the vertical side pieces of the beam forms are put in position, nailed to the soffit pieces, and braced by bottom spacers wedged in position.

The soffit pieces for the floor slab are then set on the side pieces of the beam forms with notched engagement holding them in place and leaving open the corner where the beam and floor intersect. This space is covered by a narrow curved strip of sheet iron tacked to both slab and beam pieces and thus forming an elastic fillet completing the trough system of forms.

When the concrete has set it is easy to knock out the spacers, pull the double-headed nails, collapse the forms and strip them from the concrete in separate pieces more easily handled than massive rigid box forms.

Concrete Roller Patent Suit

A patent for the use of a roller in finishing the surfaces of concrete pavements and certain features of construction of such a roller is held by the Macon Concrete Roller Co., and on March 11 it brought suit for infringement against the Brooks-Callaway Company, of Atlanta, claiming that this company has sold many rollers that infringe its patents.

Vehicles for Refuse Collection

For several months a discussion of the use of motor vehicles for refuse collection has been carried on by English engineers in the columns of "Municipal Engineering and The Sanitary Record," from which discussion we have quoted several contributions. A recent contribution, which has appeared in that periodical, was by J. A. Priestly, superintendent of the Cleansing and Baths Department of Sheffield. His conclusions, after "considerable experience in the use of motor vehicles for refuse collection," are as follows:

The question of the most suitable means of transportation to be employed depends upon a number of factors, the most important of which are the facilities for loading and the number of stops—the radius of mileage is a far less important matter. If a load can be quickly picked up at one point and delivered at a point a few miles distant without intermediate stops, petrol vehicles may show the best results; but even under these circumstances probably a steam wagon would do the work more cheaply. If the load has to be picked up from point to point, with stops of some duration, petrol vehicles cannot compete with electric under these circumstances.

In my opinion it is impossible to lay down any standard which can be generally applied in determining this matter, as the conditions governing it cannot be standardized. Speaking generally, the following principles may be considered to have been amply demonstrated:

(1) Horse transport is cheapest only on very short leads.

(2) Electric vehicles are cheapest for town collection and delivery where frequent stops are essential and the total mileage is not very considerable.

(3) Steam wagons are most economical for heavy loads from point to point where the distance is reasonable.

(4) Petrol vehicles are most suitable for long distance haulage.

A Simple Tool Holder

A convenient and efficient handle to hold a chisel point or cold cutter is illustrated in a recent publication by the National Safety Council, Chicago. It has a rod ⅜ inch in diameter and 2 feet long with a circular eye at one end and a screw thread at the other end. The rod is inserted in a ¾-inch pipe sleeve 19 inches long with an outside screw thread at one end which engages a clevis with V-shape notches in both wings.

A wing nut is screwed on the threaded end of the rod bearing on the end of the cleeve, and is set to allow the notch to register with the inner end of the eye. The circular shank of the drill point or cutter is then inserted in the eye and in contact with the notch, and the wing nut is adjusted to pull the eye towards the notch, thus holding the point or cutter firmly in position. The device is very simple, can be made by any mechanic, and will be found efficient and convenient. The interposition of a leather or rubber bushing in the socket eliminates most of the vibration caused by hammer impact.

How to Lose $1,000

The contractor for a 3-span reinforced concrete bridge in Pennsylvania was confronted with the problem of building a pier in a river bed where there was one or two feet of water with a small current and the bottom was a boulder stratum 6 or 8 feet deep underlaid by 3 feet of clay over horizontal bed rock. The boulders were not cemented by silt or other accumulations and were of moderate size, few of them exceeding one-man stones. The contractor's men wading in the water, removed as many as possible and then attempted to cofferdam the pier site by driving 2-inch square edge wooden sheeting through the remaining 4 or 5 feet of boulders above the soft bottom.

A cofferdam about 8 x 30 feet under a maximum head of 10 or 12 feet was required and the contractor built a light trestle falsework enclosing it and giving access to the shore for a working platform on which men with heavy mauls started to drive the sheeting. After long continued efforts this was found to be impossible and the contractor abandoned the attempt after spending at least $1,000 to no avail.

Had the contractor realized the impossibility of penetrating the boulder stratum and at first cleared the site as might easily have been done by a clamshell or orange peel bucket operated by the derrick already installed to handle the masonry, the cost would have been comparatively light and the work would have been greatly expedited. As it is, this method has now been adopted and the work should be carried to a successful conclusion without further difficulty.

The unsuccessful cofferdam had two lines of sheeting about 2 feet apart that with much difficulty were assembled and driven to a slight penetration. The space between the rows of sheeting was filled with a good quality of puddle and a large centrifugal pump was installed which handled a large quantity of water, but was unable to free the cofferdam because the river came up abundantly all over the bottom between the stones, making it evident that the whole structure will have to be abandoned, the cofferdam removed and the stone cleared from the bottom by clamshell or orangepeel buckets that will enable piles to be driven to bed rock and a suitable cofferdam constructed that will have a sufficient seal on the surface of the rock to permit the interior to be pumped out without great difficulty.

For an adjacent pier where the boulders were smaller and the stratum was somewhat thinner the contractor succeeded in driving a single line sheet pile cofferdam deep enough so that it cut off a large amount of the flow and a centrifugal pump lowered the water sufficiently to excavate by hand to bedrock, the sheeting of course being driven to follow down as the water was lowered and obstructions were removed under the sheet piles.

According to the F. W. Dodge Company's report, industrial building still maintains the lead over all other classes of construction activity with a total of $216,663,000 of contracts awarded during February in the territory east of the Missouri and north of the Ohio Rivers.

Important Steam Shovel Work

It is estimated that during the next five years at least 13,000,000 yards of earth and ore will be excavated and loaded by steam shovels in the Mesaba iron range in the Lake Superior district. There have already been installed there more than 150 steam shovels, most of them with 4-yard dippers, together with some of larger size including 360-ton machines with 6, 7, and 8-yard dippers.

These load directly into automatic air operated dump cars, which within the last two or three years have increased to 20 and 30-yard sizes. The latest designs have been considerably simplified and improved, enabling the cars to resist the tremendous impact of loads delivered from the large buckets and to be so quickly operated that, when they are keeping the 4-yard shovels fully occupied, it is estimated that the value of the excavation amounts to about $1.00 per minute; that is, about eight times the cost of the shovel running, and that the present cost of the excavation is about 35 cents per yard.

Cash Value of Accident Prevention

The California Safety News issued by the Industrial Accident Commission of California states that under ordinary operating conditions the annual compensation and medical cost for accidents and injuries to a working force of 6,000 men averages $127,200 and involves a time loss of 17,000 days. It also estimates that a maximum expenditure of $16,000 per year for safety appliances and otherwise reducing accidents and injuries will bring the compensation and medical cost down to $64,200 and the lost time down to 7,500 days, thus diminishing each by nearly one half.

Blasting a Concrete Bridge

A concrete highway bridge in Iowa was recently torn down with dynamite at a total cost of $29.50. Holes were made in the earth at the ends and the centers of each of the abutments 3 feet thick, which were each loaded with 5 pounds of 60 per cent. dynamite, and ten holes were drilled 2 feet deep in the abutment walls, each of them loaded with 1 pound of dynamite well tamped with moist clay. Several 3-pound chargers of dynamite were placed on top of the reinforced concrete floor and directly under them additional chargers were secured by mud caps; in all, 23 charges of dynamite were distributed over and around the bridge and were simultaneously fired by a blasting machine located 250 feet away. The 85 pounds of dynamite and 23 electric blasting caps used sufficed to entirely destroy the bridge instantaneously.

In the construction of the large earth dam at Englewood for the Miami Conservancy District, more than 100,000 yards of embankment were placed in one month and the materials dredged by hydraulic pumps, were delivered to their suction pipes through revolving screens that rejected oversize stones. The use of these screens instead of the square gratings previously installed has greatly increased the progress on the work and correspondingly decreased the unit cost. A record was made by pumping more than 6,500 yards of material into the dam during 20 consecutive hours.

Doubling up Bridge Trusses

Two old 100-foot single track spans on the Kansas City Southern Railroad had four-panel pin-connected trusses that were recently supplemented by the addition of two parallel duplicate trusses 37 inches on centers outside of the old trusses.

The new trusses were erected by suspension from the existing span and connected to the old trusses by diaphragms at the three intermediate panel points. New floorbeams were riveted to the bottom flanges of the old floorbeam and projected beyond the ends of the latter to engage vertical connection angles riveted to the diaphragms between old and new trusses. New lines of stringers were added and the tops of the piers were revised to receive the new trusses.

After erection was completed, transverse lifting beams engaging the ends of the new trusses were supported at one end on pier columns and at the other end on jacks seated on the old floorbeams and operated until the new trusses were deformed sufficiently to take the required load from the old trusses and were fixed in position to maintain this initial stress by shimming under the ends. In one bridge the cost of reconstruction was about $7,500 against $19,000 for an entirely new bridge.

Blue-Print Protector

A sheet of transparent sheeting—the same material used for lights in auto curtains—is cut to desired size. A piece of light-weight leather substitute is then cut about a half inch larger all around than the piece of sheeting. This extra half inch allows for a lap-over on all but the top side of the protector. A sewing machine stitches the lap down to the sheeting forming a large flat pocket, open at the top for the insertion of the blue prints.

Both the transparent front and the coated fabric back are waterproof and greaseproof. Dirt or grease may easily be wiped or washed off either without injury to the material. Both materials are flexible and the holder may be rolled up if desired in the same way an unprotected blue print is usually handled by a workman.

Based on the Dodge reports of building construction during 1919, Burley S. Ayer estimates that the building construction during 1920 will reach a value of $3,620,000 which corresponds to the progress indicated by percentages of increases of 1916, 1917, 1918 and 1919 of 117, 139 and 190, respectively, that are very close to the discount values of the actual purchasing power of the dollar in these years It does not anticipate much improvement in the shortage of materials, uncertain delivery and insufficient labor and disorganization of transportation that have constituted the most serious obstacles to construction work last year.

Good results in filling a large sewer trench in Panama were recently obtained by the use of a skeleton drag scraper operated by steam power. The scraper consisted essentially of a triangular horizontal transverse skeleton framework to which were attached four steel teeth inclined about 60 degrees with the horizontal bottom elements that prevented the scraper from digging too deeply below the surface.

LEGAL NOTES

A Summary and Notes of Recent Decisions—

INDEMNITY AGAINST LIENS.

(N.C.) Owner of building *held* not entitled to compel surety on the bond of the contractor to erect the building to make good to it the sum it was required to pay material men on account of failure to retain money to satisfy such claims, as required by Pell's Revisal, § 2021, when settling with the contractor; the liability not coming within the bond.—Guilford Lumber Mfg. Co. v. Holladay, 100 S. E. 597.

The owner of a building, which, after notice, in violation of Pell's Revisal, § 2021, paid to the contractor to erect the building the full amount due him when he owed material men, *held* not entitled to recover from the surety on the contractor's bond the amounts it was required to pay the materialmen, since to permit recovery would be to predicate the owner's right of action on its own breach of statute.—Id.

CONTRIBUTORY NEGLIGENCE.

(Cal.App.) Where a general contractor's employe in doing his work placed a plank across an elevator shaft, he did not assume the risk of injury by the movement of an elevator operated by the employes of defendant, the contractor installing elevators, who did so without investigating his presence on the plank and without warning, although they knew other men were working in the shaft.—Fidelity & Casualty Co. of New York v. Llewellyn Iron Works, 184 P. 402.

(Cal.App.) Though one may not willfully close his eyes to danger on the assumption that another will act with care, he cannot be deemed negligent when, if a reasonable use of his faculties does not warn him to the contrary, he rests on such assumption.—Commonwealth Bonding & Casualty Ins. Co. v. Pacific Electric Ry. Co., 184 P. 29.

(Tenn.) Any negligence on the part of plaintiff contributing directly to the injury will bar an action. —Bejach v. Colby, 214 S. W. 869.

(Tenn.) Where negligence by plaintiff is remotely connected with the cause of injury, the question to be determined is whether defendant exercising ordinary care and skill might have avoided the injury, and, if so, plaintiff's remote negligence may not be set up in bar of the action, but will be considered only in mitigation.—Bejach v. Colby, 214 S. W. 869.

PROCEEDINGS TO PERFECT.

(Cal.App.) Under Code Civ. Proc. §§ 1187, 1192, where contractors did work on a building with the knowledge, consent, and permission of the owners, no notice of completion of the work having been filed, the contractors had 90 days within which to file their claims for lien.—Krenwinkel v. Henne, 183 P. 957.

(Cal.App.) Where claimants did not file their notices of mechanics' liens, either within the time limited after the notice of completion of their original contracts, their liens are not valid because of failure to comply with Code Civ. Proc. § 1187.—Pacific Mfg. Co. v. Rasmussen, 184 P. 54.

(Cal. App.) The rule under Code Civ. Proc. § 1187, as to the 120-day period after cessation of labor within which a lien claimant may file a lien does not apply where there is an actual completion, and the 90-day provision applies, not only to cases of actual completion, but also to those of constructive completion, including completion by cessation from labor, for in such case there is no completion until there has been a cessation of labor for the period of 30 days, after which the lien claimant has 90 days within which to file his lien, by virtue of estoppel because of owner's failure to file notice of cessation from labor.—Mott v. Wright, 184 P. 517.

(Ky.) A materialman's time, of 35 days from the furnishing of the last item of the material, for giving notice of lien to the owner pursuant to Ky. St. § 2463, cannot be prolonged by furnishing material that is trivial in value and not absolutely necessary for the completion of the contract, on the mere pretext that the belated delivery was caused by oversight.—Henry Koehler & Co. v. Hines, 214 S. W. 906.

(Cal. App.) Cessation from labor by reason of actual completion of a building contract is not the cessation of labor, which, under Code Civ. Proc. § 1187, relating to filing of claim, itself constitutes a constructive completion of the building or contract. —Mott v. Wright, 184. P. 517.

The rule under Code Civ. Proc. § 1187, as to the 120-day period after cessation of labor within which a lien claimant may file a lien, does not apply where there is an actual completion, and the 90-day provision applies, not only to case of actual completion, but also to those of constructive completion, including completion by cessation from labor, for in such case there is no completion until there has been a cessation of labor for the period of 30 days, after which the lien claimant has 90 days within which to file his lien by virtue of estoppel, because of owner's failure to file notice of cessation from labor.—Id.

(Cal. App.) Under Code Civ. Proc. § 1187, as amended in 1911, in action to foreclose mechanics' liens, the statement in the second claims of lien that there was no contract price, and that the reasonable price was being charged for the work done, held not a fatal variance from the first claims of lien, stating the contract was agreed upon and was payable on completion.—Krenwinkel v. Henne, 183 P. 957.

EXTINGUISHMENT, RELEASE, OR PAYMENT.

(Okl.) Where cost of building exceeded contract price, the owner defending an action to enforce subcontractor's lien, etc., was entitled to credit for his payments to contractor who paid money to subcontractors, during 60 days within which they otherwise might have filed liens, to the extent of pro rata amounts which other subcontractors, etc., would have been entitled to if their liens had been filed in view of Rev. Laws 1910, § 3864.—J. B. Klein Iron & Foundry Co. v. A. B. Mays & Co., 184 P. 577.

NEWS OF THE SOCIETIES

April 12-17. — UNITED STATES GOOD ROADS ASSOCIATION. Eighth Annual Convention, Hot Springs, Ark. Director-General, J. A. Rountree, 1021 Brown-Marx Building, Birmingham, Ala.

April 16-17. — BANKHEAD NATIONAL HIGHWAY ASSOCIATION. Fourth Annual Convention, Hot Springs, Ark. Secretary, J. A. Rountree, 1021 Brown-Marx Building, Birmingham, Ala.

April 27-29—CHAMBER OF COMMERCE OF THE UNITED STATES. Eighth annual meeting, Atlantic City.

May 10-11.—AMERICAN ASSOCIATION OF ENGINEERS. Sixth Annual Convention, St. Louis, Mo. Secretary, C. E. Drayer, 63 East Adams Street, Chicago.

May 13-14-15.—LEAGUE OF TEXAS MUNICIPALITIES. The eighth annual convention will be held at Dallas, Tex. Secretary-Treasurer, Frank M. Stewart, University of Texas, Austin, Texas.

May 18-21.—NATIONAL ELECTRIC LIGHT ASSOCIATION. Annual convention, Pasadena, Cal. Acting Secretary, S. A. Sewall, 29 West 39th Street, New York City.

June 22. JOINT COMMITTEE ON STANDARD SPECIFICATIONS FOR CONCRETE AND REINFORCED CONCRETE. Next meeting at Asbury Park. Secretary-treasurer, D. A. Abrams, Lewis Institute, Chicago.

June 21-25.—AMERICAN WATER WORKS ASSOCIATION. Annual meeting, Montreal, Canada. Secrtary, John M. Diven, 153 West 71st Street, New York City.

Oct. 4-8. — AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention, St. Louis, Mo. Secretary, Charles Carroll Brown, 404 Lincoln Avenue, Valparaiso, Ind.

World's Road Congress.

Through the state department of the American Counsul General at Paris, the United States has been invited to join the permanent international association of road congresses. The Executive Committee of the American Association of state highway officials, recommends to the Secretary of Agriculture, that the invitation be accepted and Secretary Meredith concurred in this and promised to recommend to the state department that Congress be asked to authorize acceptance. The highway officials also recommended that the International Association be invited to the United States for its next meeting. Thomas H. MacDonald, chief of the Bureau of Public Roads, says that the United States is the only civilized nation not now a member of the International Association which constitutes an International Tribunal for bringing together the best experience and results in highway construction and administration. Meetings have been held in Brussels, Paris and London, but have been suspended during the war.

American Association of Engineers.

The Nebraska Engineering Society voted on March 8 to amalgamate with the American Association of Engineers. The following officers have been elected by the Los Angeles Chapter: Frank H. Joyner, president; A. L. Harris and H. Z. Osborne, Jr., vice-presidents, and R. H. Holbrook, secretary. William D. Armstrong, Myron Hunt, F. C. McMillan and F. H. Olmsted are directors.

A committee representing Engineering Council discussed the council's compensation report. This committee consisted of Arthur S. Tuttle, chief engineer, Board of Estimate and Apportionment, New York City; Colonel Bion J. Arnold, consulting engineer, Chicago, and Oscar C. Merrill, chief engineer, U. S. Forest Service, Washington, D. C.

The twenty thousand railroad professional engineers of the United States were represented at the hearing of the Interstate Commerce Commission on March 15 by a committe of the A. A. E., consisting of L. K. Sherman, president of the United States Housing Corporation, District Secretary R. C. Bailey, and C. H. Wisewell. The hearing was called in compliance with the terms of the Transportation Act to determine which employes are to be classified as "subordinate officials and other employes," and for promulgating other rules governing nominations for appointment to the Labor Board.

The A. A. E. was the only organization of professional engineers which had delegates at this meeting.

The representatives of the Railway Executives contended that all engineers should be included in the "official" group.

The Michigan Engineering Society has voted in favor of the amalgamation of the society with the A. A. E. by a letter ballot just completed. The new organization will be known as the Michigan Engineering Society.

The St. Joseph Chapter of the A. A. E. has elected J. C. Holland, chief engineer of the St. Joseph Structural Steel Company, as president; George S. Yant, valuation engineer of the St. Joseph and Grand Island Railway, and Glen B. Riddle, of the St. Joseph Structural Steel Company, vice-presidents; Clayton O. Judson, city engineer of St. Joseph, secretary, and W. B. Hazen, consulting engineer, treasurer. A. A. E. chapters have been granted members petitioning from Flint, Michigan; Corvallis, Washington; Minot, N. B., and club certificates to members petitioning from Atchison, Kansas; Boise and Idaho Falls, Idaho. The membership of the A. A. E., on March 16, was 14,100 with 6,143 applications for membership pending.

The officers elected for 1920 by the Newark Chapter are Frederick A. Reimer, president; Robert A. Meeker, Morris R. Sherrerd, David Boswell and Thomas J. Wasser, vice-presidents, and D. W. Krellwitz, secretary and treasurer. The chapter has already passed a resolution urging that a civil engineer be appointed to serve on the New Jersey bridge and tunnel commission either in an active or ex-officio capacity, not as reflecting any criticism on the existing boards or its method of work, but to insure to the board and to the people of the state full information relative to the engineering details involved in any project.

Federal Highway Council.

As the national body around which highway educational activities are now being centralized, the Federal Highway Council occupies an unique position in building for better transportation. It has a direct affiliation with more than eleven hundred organizations throughout the entire country representing the public welfare and commercial interests of millions in population. From those organizations, as their representatives, fifteen thousand nominations have already been received for membership in the Council.

In the face of high cost for both materials and labor, and the fact that in some states construction programs must be altered somewhat to meet existing labor and material conditions, there is no tendency upon the part of the people to slow down in their plans to place the nation's highways upon a higher plane in the country's transportation system.

A curious fact is that the building of roads is seriously hindered by the same evil which they are designed to remove—lack of transportation facilities. According to authoritative information, production is halted to a greater degree by inadequate transportation facilities than by labor shortage, at least in production of road building materials.

Increased Engineers' Salaries Requested.

Senator Calder of New York has proposed an amendment to the Rivers and Harbors Bill, which has passed the House and is in the hands of the Senate Commerce Committee, providing for a 25 per cent increase of salary for assistant and junior engineers and chief clerks employed in connection with the improvement of rivers and harbors or on the construction of fortifications.

Railroad Conference.

At the second annual railroad conference of the American Association of Engineers, held in Chicago on March 15, there was a decided majority in favor of an assessment of $2.00 for each railroad member to meet the expense of a national railroad secretary and a railroad department. The meeting favored the maintenance of a national railroad department under a paid railroad secretary.

A telegram was sent to the Interstate Commerce Commission asking that C. E. Lindsey, a professional engineer and a member of the Board on Wages and Railway Working Conditions of the U. S. Railroad Administration, be placed in nomination for appointment to the Railroad Labor Board provided for by the Cummins-Esch Bill. Among the addresses were those of Samuel M. Felton, president of the Chicago Great Western Railroad, who spoke on the problem of the railroads since their return to private management; George W. Hand, assistant to the president of the Chicago and Northwestern Railway, who advocated section activities which will train engineers for executive positions; W. C. Bolin, chairman of the A. A. E. sub-committee on salaries; F. H. Newell, president of the American Association of Engineers; J. B. Jenkins, valuation engineer of the Baltimore and Ohio, and F. B. Morrow, chief engineer of the Chicago and Western Indiana.

State of New York—The Civil Service Commission.

Examinations for the State, County, and Village Service, April 10, 1920, Architectural Draftsman, Grade 8, $1,501 to $1,800. Several appointments expected in the office of the Transit Construction Commissioner, New York City. Inspector of Equipment, Public Service Commissions and Office of Transit Construction Commissioner. $1,501 to $1,800. Open only to those who have had at least 5 years of practical car-house or car-shop experience. Inspector of Equipment (Boilers), Public Service Commission, Second District. $2,040 to $2,800. Inspector of Lumber, Public Service Commissions and Office of Transit Construction Commissioner. $1,501 to $1,800. Candidate must have had at least five years of experience as inspector of lumber, general foreman of a lumber company or otherwise as responsible employee in the grading of the woods. Junior Electrical Engineer, Public Service Commissions and Office of Transit Construction Commissioner. $1,501 to $1,800. Several appointments expected. Junior Engineer (Civil), Grade 8. $1,501 to $1,800. Several appointments expected in the office of the Transit Construction Commissioner, New York City. Junior Engineer (Civil), Grade 7. $1,201 to $1,500. Several appointments expected in the Office of the Transit Construction Commissioner, New York City. Application forms will not be sent out by mail after March 29, 1920. Applications received at the office of the Commission after March 31, 1920, may not be accepted.

For application form, address a postal card to State Civil Service Commission, Albany, N. Y.

Withdraw Engineers' Registration Bill.

Senate Bill No. 91, introduced in the Legislature of Virginia by the Engineers' and Architects' Association of Lynchburg, which provided for registration of professional engineers, has been withdrawn at the request of the Richmond and Tidewater Virginia chapters of the American Association of Engineers. These organizations felt that the bill was not representative of the conclusion that have been reached regarding requirements of registration bills, and have since caused the introduction of Senate Bill No. 226, which contains many improvements over the one withdrawn.

PERSONALS

Herrold, George H., Office Engineer, Department of Public Works, St. Paul, Minnesota, has been appointed Managing Director and Engineer of the St. Paul City Planning Board effective March 15, 1920. This is a newly created position brought about by ordinances providing for a City Planning Board to study the physical conditions of the City and prepare a comprehensive plan for its future development.

Randolph, Isham, of Chicago, addressed the Detroit Real Estate Board on March 11 on "The Lakes to the Atlantic Waterway."

Painter, Captain P. C., of the U. S. Army Engineer Corps, has joined the engineering staff of the eastern paving brick manufacturers association as district engineer.

Wadsworth, G. H., has resigned as assistant engineer of the California Debris Commission and has opened in San Francisco an office as consulting engineer to specialize in water utilization and flood protection.

Brunning, H. D., chief engineer of the Ohio Highway Department has resigned that position and entered the service of the Ohio Paving Brick Manufacturers Association.

Clark, Frank M. has resigned the position of superintendent in charge of paving for the Barrett Co., Ltd., Canada, and has been appointed as assistant chief engineer of the Nova Scotia Highway Department, headquarters at Halifax, N. S.

Norton, R. M., engineer of the Sacramento Co., Cal., has resigned to become engineer of San Diego Co., Cal.

Winslow, G. R., formerly first assistant engineer of the California State Highway Commission, has been appointed division engineer of Division 3.

Lau, P. M., highway engineer of Oakland Co., Mich., has resigned to undertake highway contracting work.

Wheeler, Major Robert C., until recently chief of the water supply section of the construction division of the United States Army, was discharged from the service about Mar. 1, on Mar. 3 was married to Miss Margaret Lappe, Pittsburgh, and on Mar. 16 sailed for Athens, Greece, with a party of engineers organized by Ford, Bacon & Davis, to prepare plans and estimates for the water supply and sewage of Athens.

Barker, Harry, and Wheeler, Robert C., have formed an association with offices at 170 Broadway, New York City, for the general practice of engineering. Mr. Wheeler will be in charge of the work on water distribution, sewage and collection, for the city of Athens, Greece.

Cranch, E. I., has been appointed assistant engineer of the Kansas State Board of Health.

Hayler, G. W., has accepted a position on the staff of the city planner of Boston, with headquarters at Cambridge, Mass.

Campbell, G. L., has been appointed division engineer of the Kansas State Highway Commission, at Salina, Kans.

Wilcox, John W., city engineer of Macon, Ga., died recently.

Gregory, Charles E., deputy chief engineer of the North Jersey District Water Supply Commission, died February 21 at East Orange, N. J.

Simpson, Guy Co., consulting engineer, San Antonio, Texas, died Feb. 16.

Smith, Felix R., formerly assistant engineer of Nashville, Tenn., died Feb. 12.

Beattie, W. S., city engineer of Charles City, Ia., died Feb. 7.

Sheppard, J. W., managing engineer of the Gem Irrigation District, Idaho, died Feb. 12.

Dysard, E. E., president of Dysard Construction Co., Atlanta, Ga., died recently.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Installations

Giant Precast Piles.

Giant piles designed to be efficient under heavy driving have a rectangular concrete crôss section reinforced by four full length bars having their lower ends hooked into the web of permanent cast iron points made with a flange at the top to give bearing for the lower ends of a detachable steel driving frame that encloses the pile shaft and receives the hammer impact.

Piles of this type, 16 inches square, were driven without injury through 2 feet of earth, 4 feet of brickwork, 14 inches of solid pine timber, 24 inches of brickwork and 10½ feet of stiff blue clay and sticky blue sand to a refusal of ¼ inch under 60 blows of a 7,500 pound Warrington steam hammer with 48-inch stroke. Under New York building regulations, these piles were good for loads of about 65 tons each.

New Battery Charging Outfit.

A small portable battery charging outfit has recently been placed on the market by the Westinghouse Electric and Manufacturing Company for charging automobile batteries from an ordinary alternating-current house lighting circuit. It is rugged, reliable and of simple construction. It has no moving ports; uses no oil or grease, and is not affected by heat or cold. The principal parts of the outfit are a transformer, a rectifier bulb, and a fuse for protecting the apparatus.

The outfits are designed to give rated amperage at normal line voltage to three cells, and about two-thirds this current at normal line voltage to six cells. They are furnishd in two sizes, one with a direct-current rating of 2½ to 1½ amperes and a larger size with a d. c. rating of three to six amperes. The approximate net weight of the smaller outfit is 9¼ pounds and that of the larger, 21 pounds.

Centrifugal Pumps.

The Dayton-Dowd Company announces the opening of a branch office in Cleveland, Ohio, under the management of Mr. L. E. Maher of the Maher Engineering Company, of Chicago.

Portable Air Compressors.

The Ingersoll-Rand Co. has recently put on the market the new Imperial type 14 portable compressors in two sizes, one having a capacity of 118 cubic feet and weighing 400 pounds and another of 210 feet weighing 600 pounds. They are especially designed for lightness, strength, durability and efficiency, and are wholly self-contained with long stroke gasoline driving motors operating at medium speed. They are water cooled and are equipped with automatic governors maintaining constant speed under all working conditions and preventing over speed when idle.

Dump Wagons.

Studebaker, South Bend, announces the sale of its dump wagon business to the Western Wheeled Scraper Co., Aurora, Ill., who will continue the manufacture of Studebaker model dump wagons and will furnish extra parts and repair parts on order. Studebaker will specialize in farm wagons which will receive the full benefit of their 67 years' practical manufacturing experience.

Mechanical Memory.

The Mechanical Memory System Co., Aurora, Ill., are the manufactureres and distributors of a visible controlled system calculated to provide for the manager's desk a mechanical memory and to afford at all times a visible schedule of pending work. Complete information describing the method of operation will be mailed on request.

United States Locomotive Cranes.

Bulletin 190 of the United States Crane Company describes 20-30-ton locomotive cranes with booms 40, 45, 50 and 55 ft. long that are equipped with grab buckets, blocks or magnet. The shipping weight is 120,000 pounds, fuel and water supply, 9,000 pounds, ballast, 30,000 pounds. The engines are of vertical type with 10-inch double cylinders of 10-inch stroke and the 54-inch vertical boiler is 9½ feet high with 124½-inch tubes carrying 125 pounds steam pressure and having a great area of 12½ square feet and a grate surface of 550 square feet. The draw bar pull is 9,000 pounds approximate, and the hoisting speed is 280 feet per minute single line, with engines running 300 R.P.M. The swinging speed is 3 revolutions per minute and the travel speed 600 feet per minute. The cranes can operate on a maximum grade of 6 per cent without a train load and can pass around a 60-foot curve. The lifting capacity without track clamps or outriggers is 20 tons at 15-feet radius or 4 tons at 50-feet radius. The tipping load is 35 per cent higher than the safe load.

Leader Crawler Tractors.

These tractors are recommended by the Dayton-Dowd Company for road work on account of their great power, light weight, durability and flexibility. They are made in two sizes and burn from 18 to 30 gallons of kerosene oil daily. They are built with two light smooth face front wheels and are mounted in the rear on a four-wheel truck with caterpillar traction, and Hyatt roller bearings. They have a forward and reverse speed of 2 miles and a high speed of 3¼ miles per hour; transmission is of the automobile selective type with sliding gear. All gears are of cut steel and the heavy channel bar frame is heavily braced and trussed. Both sizes have a 98-inch wheel base and a shipping weight of 6,200 pounds or 6,500 pounds.

Scoville Pump Valves.

The important features in the desige of these valves, sold by the Richardson-Phoenix Co., are the employment of a compressible material to seal the metal valve and the elimination of valve resistance and disturbance of fluid, thus maintaining a uniformity of flow. The principal advantages claimed are the strength to withstand pressure and wear, elimination of leakage and slippage, proper spring tension, an uninterrupted fluid flow and elimination of eddies, and low cost of renewals and ease of repair.

Sealing is not produced by the valve seating directly on the rings, but by the pressure of the fluid forcing the rings against the beveled edges of the vales. The springs are of phosphor bronze wire and the seat ports are straight. Renewals involve only the purchasing of a new set of seals about once a year.

During Feb. 1920, the American-La France Fire Engine Co. made 38 sales of apparatus, including pumping engines, simple combinations, and service trucks that were shipped to 15 different states and to Japan.

PROBLEMS CITIES ARE STUDYING WITH EXPERTS

Elmira, N. Y., has held a public meeting under the auspices of the Business Men's Association to discuss the adopting a CONCRETE ARCH TYPE OF BRIDGE at Main street, where the subject was presented by B. H. Davis, New York, concrete bridge specialist.

Metcalf & Eddy, consulting engineers of Boston, have been engaged by the Syracuse intercepting sewer board to go over plans for the SEWAGE DISPOSAL PLANT which the board plans to put up here within the next two years.

The plans, on which Glenn D. Holmes, the board's engineer, and Henry C. Allen, city engineer, collaborated, are now ready for approval. In the meantime sewage will be concentrated at a point on the lakeside and dumped into the lake.

A $5,000,000 structure to be known as the Peace Memorial Bridge, across the Niagara river from Buffalo to Fort Erie, has been proposed and Congress has appointed a committee to investigate its cost and commercial possibilities.

In accordance with a plan promoted by the governors of several western states, there has been prepared a congressional bill authorizing the appropriation of $250,000,000 for the reclamation of arid lands.

Pryor Creek, Okla., will construct on Grand river a water surface PURIFICATION PLANT AND ELECTRIC PUMPING EQUIPMENT with 8 miles of transmission line at an expense of about $75,000. The consulting engineers are V. V. Long & Company.

Cedarberg, Wis., has made surveys for the construction of a WATERWORKS AND SEWERAGE SYSTEM. W. G. Kirsthoffer, engineer. The cost is estimated at nearly $200,000.

St. Louis, Mo., plans the extension of the urgently needed HARLAN CREEK SEWER at a cost estimated by W. W. Horner, engineer of the Board of Public Service at $300,000.

Plans for the Bell City DRAINAGE DISTRICT No. 1 have been completed by Shultz & Sons, Lake Charles, La. Bonds for $225,000 will be issued.

The Burlington, N. J., common council has appointed a committee to make an investigation as to the advisability of purchasing the plant of the Burlington Sewer Co. and making it one of the city's assets.

The cities of Newark and Elizabeth are participating in conferences with the chief engineer of the Jersey Central Railroad on the construction by the latter of a new bridge across Newark Bay.

INDUSTRIAL NEWS

Standard Specifications for Concrete.

The joint committee on Standard Specifications for Concrete and Reinforced Concrete has just been organized. The committee consists of five representatives from each of the following organizations:

American Society of Civil Engineers, American Society for Testing Materials, American Railway Engineering Association, Portland Cement Association, American Concrete Institute.

The purpose of the committee is to make a thorough study of all available data on the subject of concrete, concrete materials and reinforced concrete and to incorporate the most modern information and experience into a general specification which may serve as a pattern for detailed specifications for specific types of concrete constructions.

The organization meeting of the committee was held at the Engineers' Club, Philadelphia, on Feb. 11. The following officers were elected:

R. J. Humphrey, chairman, Philadelphia; J. J. Yates, vice-chairman, New York City; D. A. Abrams, secretary-treasurer, Chicago.

The following committees, consisting of five to seven members each, have been organized:

Concrete materials, metal reinforcing, proportioning and mixing, forms and placing, design, details of construction, waterproofing and protective treatment, surface finish, form of specification.

A number of the committees have organized and are actively engaged in the preparation of their preliminary reports. The next meeting of the committee will probably be held at Asbury Park, N. J., about June 22, during the annual convention of the American Society for Testing Materials.

Standard Steel Buildings.

The Blaw-Knox Company of Pittsburgh, Pa., have purchased the C. D. Pruden Company of Baltimore, Md., who are manufacturers of standardized steel buildings for industrial plants, warehouses, cottages and garages.

Campbell, J. Grier, purchasing agent of the Blaw-Knox Company, has resigned to become assistant treasurer of the C. D. Pruden Company.

Boyd., Wm. S., formerly assistant purchasing agent of the Crucible Steel Co., and purchasing agent of the Page Steel and Wire Co., has been appointed purchasing agent of the Blaw-Knox Company.

Henry Exall Elrod Company, general and consulting engineers, Dallas, Tex., has issued a very handsome illustrated booklet describing the personnel and work of the organization. Besides Mr. Elrod, the organization includes David Brennan, Frank W. Chappell, John J. Barlow, Alexander M. Vance, Dudley M. Wilson, Robert E. Schiller and Jack T. Nash. The training and experience of these men are described.

Maher Engineering Company Opens Cleveland Office.

The Maher Engineering Company, located at 30 N. Michigan Boulevard, Chicago, announce the opening of a branch office at 708 Schofield Building, Cleveland, Ohio, handling the distribution of Erie Engine Works, constant and variable speed, high and low pressure engines; Dayton-Dowd Company centrifugal pumps and centrifugal fire pumps; Galland-Henning Mfg. Co. hydraulic balers and presses. The office will be under the management of Lincoln E. Maher.

Mack Has New Cincinnati Branch.

The International Motor Company of New York, manufacturers of Mack Trucks, announces the opening of another branch at 1426-28 Central avenue, Cincinnati, Ohio. The branch will operate under the name of the Mack-International Motor Truck Corporation, superceding the James Kidney Company who were Mack dealers in that territory. G. K. Ross will be in charge.

The Law of Government Contracts.

By R. Preston Shealey, of the Bar of the Supreme Court of the United States, Ronald Press. Part I contains chapters on Comparison of government and individual contracts, classes of contracts, and when a government contract is valid; Part II, Implied contracts; Part III, Performance; Part IV, Breach, and Part V, Procedure, and an Appendix.